CHILDREN'S BOOK OF FACT AND FANCY

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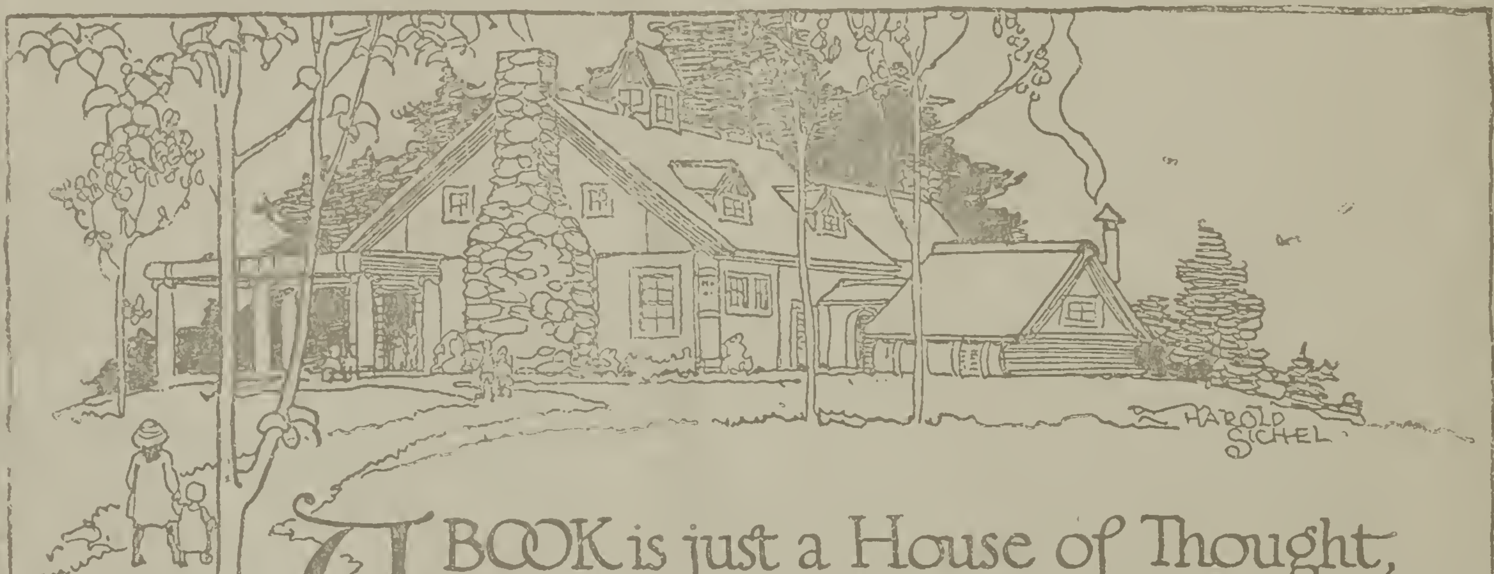

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And all its Dwellers give and give.
So walk right through the open door
With kindly Heart and brain awake.
You'll find in there a Wonder Store
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That's all they *ask* for all we *learn*.

John-martin

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For *years* and *years* the Tree has grown.
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Have cared for it, so now it spreads
Its Roots and Branches far and wide,
And casts its shade on every side.

❧

This Tree bears Fruit of different kinds
For many Hearts and many Minds.
So all you Children have to do
Is just to take what's *best* for you.
But no one ever soils or breaks
The Golden Fruit he *needs* and takes,
And no one ever bends or tears
The Books this Tree of Knowledge bears.

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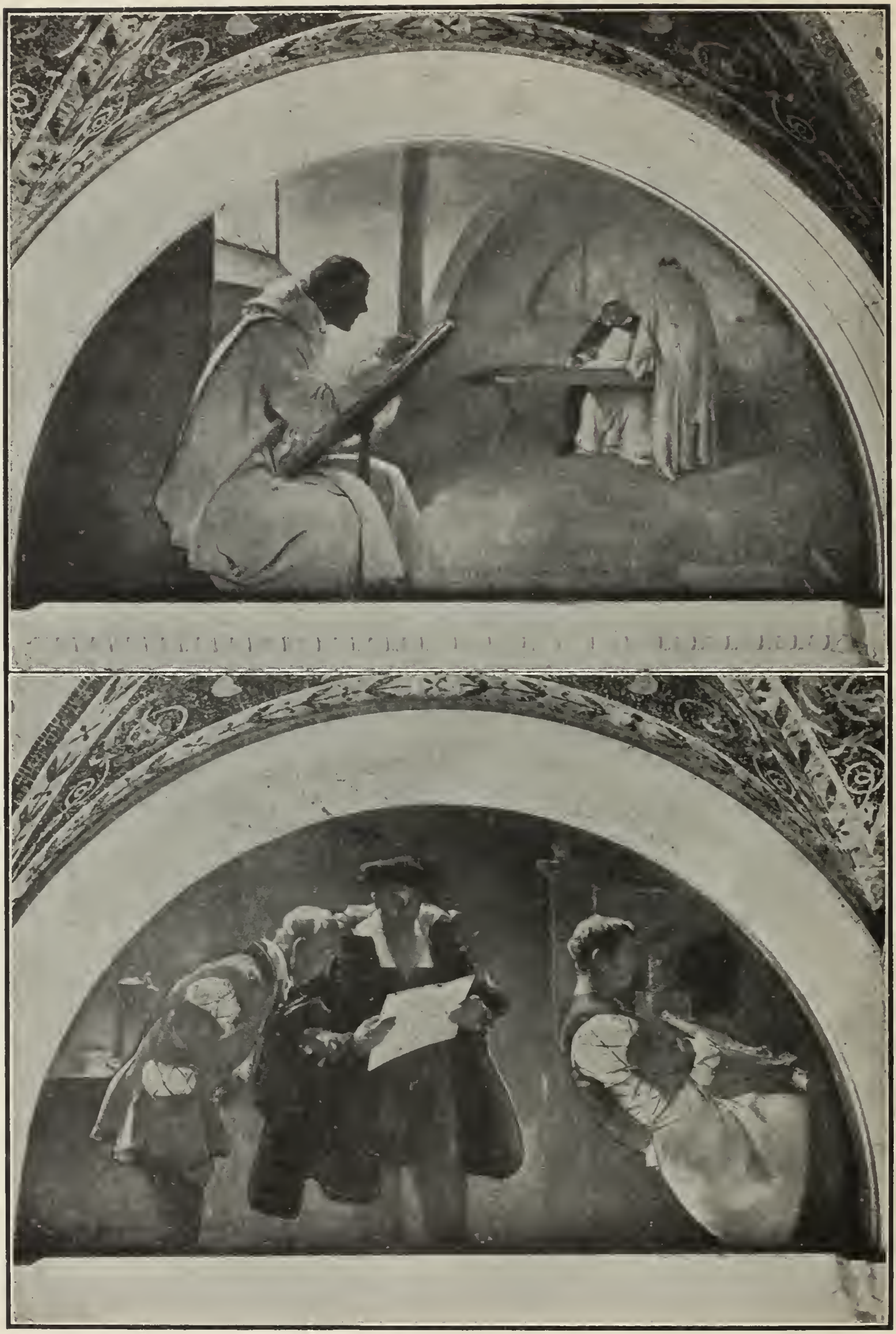

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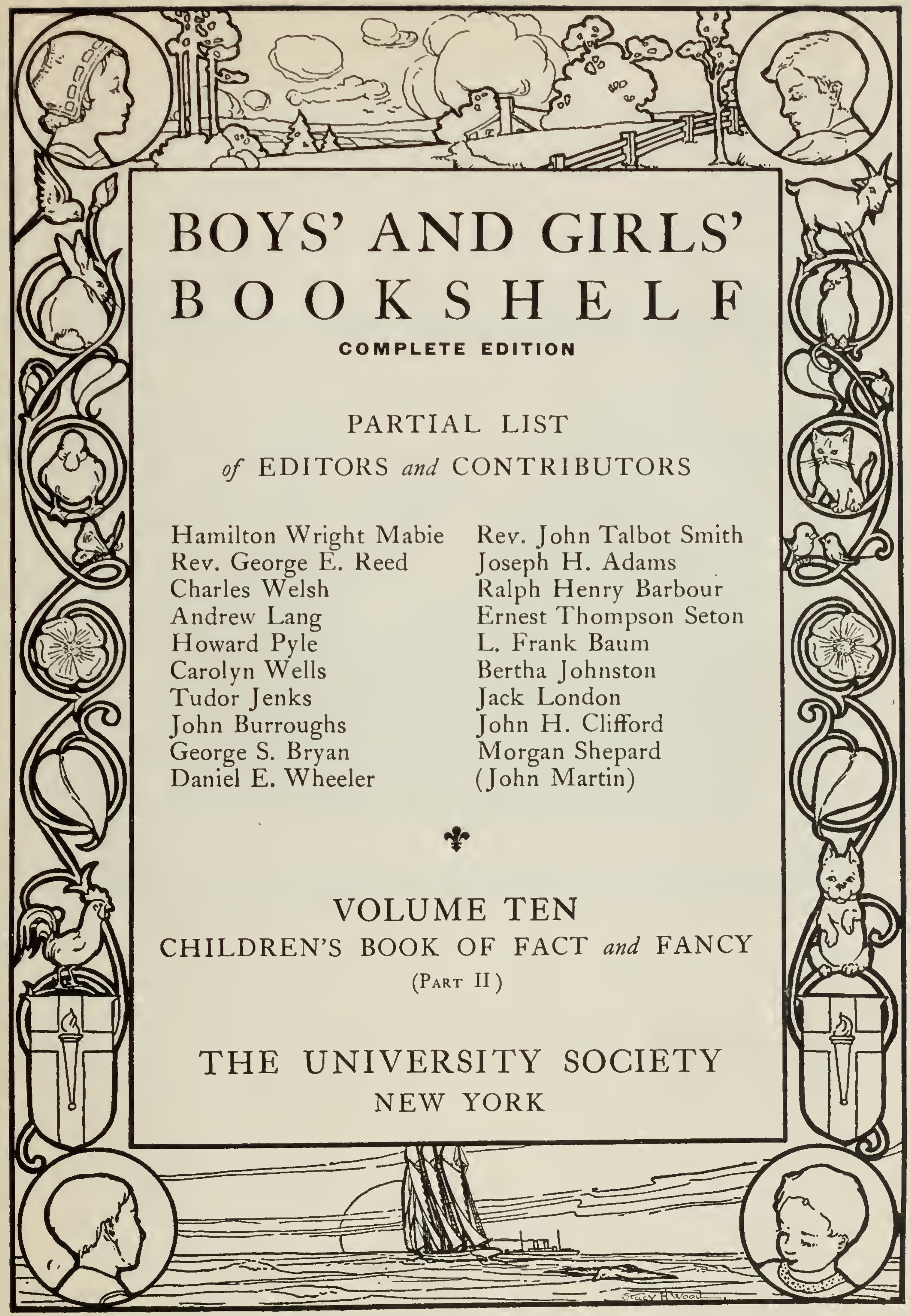

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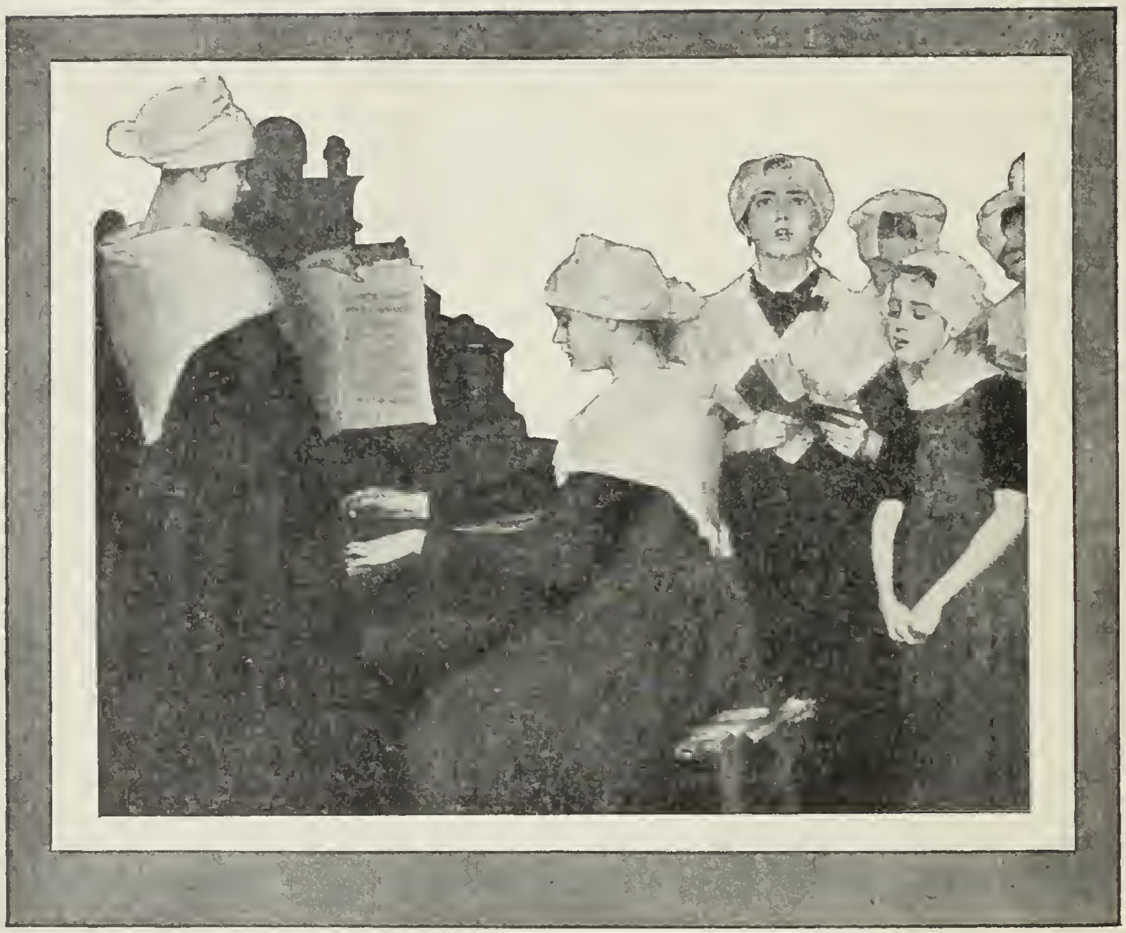

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CHAUCER'S CANTERBURY TALES

The most famous of the writings of Geoffrey Chaucer, the first great English poet, is the work known as "The Canterbury Tales." Its plan is simple. We are to imagine a company of "pilgrims"—which did not mean religious people, but good and bad alike—setting out from the Tabard Inn, at Southwark, in April, 1387, some on horse and some on foot, to visit the shrine of St. Thomas à Becket, at Canterbury. The landlord of the inn proposes that each pilgrim, to pass the time, shall tell a story on the way to Canterbury, and another on the way back. As there are thirty-three persons in the company, including Chaucer himself, that would mean sixty-six tales, but the poet only wrote twenty-four. Though the book is incomplete, it is longer than the "Iliad." Seven of the stories have been chosen for retelling here. Our language has changed so much since Chaucer's time that many words have to be altered, and some syllables have to be pronounced which are not sounded now. In our quotations these are marked with accents, like "calléd."

THE PATIENCE OF GRISELDA—THE TALE TOLD BY THE CLERK

A "CLERK" in Chaucer's time meant a student, or any learned person. In England people still speak of a clergyman as a "clerk in holy orders." This is the story told by the student to his fellow-pilgrims:

A gifted but pleasure-loving nobleman named Walter, lord of the noble country of Saluces, in Italy, was asked by his subjects to marry, so that an heir might be left to them when he had gone. Near by his palace was a little village, which the marquis passed through when he went hunting.

Among the poor folk of this village dwelt a man called Janicula, who had a daughter, "the fairest under the sun." This humble maiden, whose name was Griselda, was as virtuous and dutiful and hard-working as she was beautiful. Often, when on his way to the chase, had the marquis's eye rested on Griselda, and, bearing in mind his people's wish, he determined that if he did marry she should be his wife.

He had fixed a day for his wedding, as his people had desired, but the day came and still none knew who was to be the bride.

All preparations were made for the ceremony. Costly dresses were made, gems prepared for his lady that was to be, and a gallant company were invited to the feast. Then a brave procession, headed by the marquis, set out from the palace to escort the bride. The marquis led the way to the little village.

Here Griselda was busily engaged getting her household tasks done, so that she might afterward stand at her father's door and see the wedding procession. As she was setting out to draw water at the well, the marquis stopped the procession at her rude dwelling, and, calling her by name, at which she almost swooned, asked for her father. Griselda answered that he was within, and then brought him forward. After conferring with her father, the marquis asked Griselda if she would marry him, giving him all obedience. Griselda pleaded her unworthiness of so much honor, but replied that if it was her lord's will she would marry him and obey him in all things. Then the marquis, taking her hand, led her forth from the hut, and said to his people, "This is my wife. Honor and love her as you love me."

Griselda was straightway dressed in royal robes, and, looking more lovely than ever, was set on a beautiful horse, on which she rode to the castle, where the marriage was celebrated with much feasting.

Walter and she then lived for a time in great happiness, Griselda winning all hearts near and renown afar. Then was Walter moved to try her obedience sorely. When a little daughter was born to them he told her that his people were displeased, and that she was the cause of the trouble. Obedient to her husband's wish, Griselda gave up her child, thinking she would never see it any more. So, when a son was born, him also she gave up. Then the marquis, chiding her with her lowly origin, though her conduct was such that one born and reared to fill a great position might have been proud of it, said that she must return to her father to make way for another whom he was to marry. In this, as in all other things, was Griselda submissive.

The people, who loved her, were angry at the marquis's cruelty. But when the new bride came in state with her brother from Bologna, and the people saw that she was fairer and younger than Griselda, they, with the fickle hearts of the crowd, thought that the marquis had done well.

Yet was Griselda to be further tried, for the marquis sent for her to greet the new arrivals, because she alone knew how such ceremony should be carried out. So in her humble attire Griselda went back to the castle to obey her cruel lord's behest. And all the guests wondered who this humble and beautiful lady was that knew such honor and such reverence. At last, when the feast was spread, the marquis called for Griselda, and, as if in jest, asked her how she liked his new wife.

"Right well, my lord," quoth she; "for in good fay,
A fairer saw I never none than she.
I pray to God give her prosperity;
And so hope I, that he will to you send
Pleasaunce enough unto your lifé's end.
One thing warn I you, and beseech also,
Hurté not ever with no tormenting
This tender maiden, as ye have done me;
For she is fostered in her nourishing,
More tenderly, and to my supposing
She could not adversity endure
As could a pooré fostered créature."

And when Walter saw her patience under this great trial, his heart was at length touched.

"'T is enough, Griselda!" he cried. "Be no more afraid. Now know I, dear wife, your steadfastness." He took her in his arms, and sought to comfort her, so overcome was she at what he said. He told her that it was her own daughter whom she had just received as his new bride, and that the boy was her son. He had sent the two to Bologna, where they had been fittingly cared for and brought up secretly. Griselda was then dressed in the royal robes; there was great rejoicing, and the rest of her life was full of happiness. Says the poet:

Full many a year in high prosperity
Lived these two in concord and in rest,
And richly his daughter married he
Unto a lord, one of the worthiest
Of all Italy; and then in peace and rest
His wife's father in his court he keepeth,
Till that the soul out of his body creepeth.
His son succeedeth in his heritage,
In rest and peace after his father's day;
And fortunate was eke [also] in marriage,
Though he put not his wife in such a say.
This world is not so strong, no, by my fay,
As it hath been, in oldé timés yore,
And hearken what this author saith therefore.
This story is said, not for that wivés should
Follow Griselda in her humility,
For this could not be borne, no, tho' they would;
But for that every wight in his degree
Shouldé be constant in adversity
As was Griselda.

THE FOX REPAID IN HIS OWN COIN —THE TALE TOLD BY THE PRIEST

There was once a poor widow, in the little yard attached to whose dwelling was a very fine cock, called Chanticleer. One morning this bird awoke with terror and told his mate, Pertelot, of a horrible dream that he had had, of a beast like a hound that threatened him. Dame Pertelot laughed her Chanticleer's fears to scorn. It was, said she, the result of indigestion, for which she suggested that he should take certain medicines.

While Chanticleer was enumerating stories of dreams that had come true, he looked upon Dame Pertelot's face, and, taking courage, begged that they should talk of cheerful things. By this time daylight had come, and, descending from his perch, Chanticleer strutted around like a lion, clucking whenever he found a corn.

But one day, as he was proudly walking about the yard, crowing at the sun, he spied a fox that had crept in the night before and hidden in a bed of herbs. Then Chanticleer, reminded of his dream, would have fled, but the fox, addressing him, said:

"Gentle sir, alas! why would ye go? Be not afraid of me. I am your friend. I only came to hear you sing, for, truly, to you as sweet a voice is given as any angel hath that is in heaven. Your father and your mother both have been in my house. I never heard any one except you sing so well as your father did. Let us hear now if you can imitate your father."

Chanticleer, much flattered by the remarks of the sly fox, stood high upon his toes, stretched his neck, made his eyes to close, and began to crow right loudly. Then Dan Russel, the fox, jumping up, seized him by the throat, and fled with him toward the wood.

Such an alarm was then raised by Dame Pertelot and the other hens that the widow and her daughters ran out of their dwelling and, seeing how matters stood, called the neighbors, who joined in the chase. Jack Straw and all his company never made such a to-do as was caused by the chase after the fox and Chanticleer. But as he was lying helpless in fear on the fox's back the cock thought of a plan, "Dear sir," said he to his captor, "if I were you I would turn on yon proud fellows and tell them that, now I am near the wood, the cock shall here abide, and I will surely eat him, when I choose, whatever you may do."

"In faith," declared the fox, "it shall be done."

But as he spoke the cock slipped from his mouth and quickly flew high up on a tree out of reach. The fox then cried that he was sorry for frightening the cock. He did it, he said, with no base intent; and if Chanticleer would only come down again he would tell him why he had acted as he had done.

But Chanticleer replied that he had been deceived once and would not be deceived again. And so the fox was paid in his own coin—flattery.

THE STRANGE ADVENTURES OF A PRINCESS—THE TALE TOLD BY THE LAWYER

Constance, the daughter of the Emperor of Rome, was of such goodness and beauty that when travelers returned from that city they could not sing her praises too highly. The Sultan of Syria heard of her from his merchants, and was so affected by their reports that he sent word to her father offering to become Christian, with all his nobles, if he might have her hand in marriage.

The marriage took place; but the Sultan's mother, who was secretly opposed to the union, invited the bride and bridegroom, and all the Christian knights who accompanied them from Rome, to a great feast, at which she caused them to be treacherously murdered, all save Constance. Her she sent adrift to sea in a rudderless boat, with all the rich wedding gifts and a store of food and raiment.

In this frail bark Constance was driven far, and finally cast on the shores of Northumberland. Here she was found by the constable of a castle which stood near, and he and his wife, Hermyngyld, befriended her and became Christians.

A young knight of Northumberland, being refused by Constance, sought to bring her to a shameful death. He killed Hermyngyld secretly and accused Constance of the crime. She was tried before King Alla of Northumberland, whose gentle heart was touched with pity by her tears. A miracle occurred, which was thought to prove her innocence; so the false knight was put to death, and she became King Alla's wife.

But Alla had a mother, who was bitterly opposed to this marriage, and in her son's absence had Constance once more sent adrift with her baby boy. When King Alla discovered this, he killed his wicked mother with his own hand, and gave himself up to grief and lamentation. Meanwhile, Constance and the little Maurice were rescued from a heathen land on which they had been cast, and eventually taken to Rome, where they were befriended by a senator and his wife.

All this time Constance kept her pitiful story to herself, but her goodness caused her to be beloved by all.

Then King Alla, smitten with repentance for the death of his mother, journeyed on a pilgrimage to Rome, where he was received by the very senator who had befriended Constance; and, being invited to a feast by Alla, the senator took young Maurice with him.

Attracted by the child's face, Alla asked as to the boy's history. Musing on all that the senator could tell him, and full of thoughts of the wife he mourned as one that was dead, Alla afterward went as a guest to the senator's house. Here Alla and Constance met, and knew one another immediately. Constance, who thought it was by Alla's orders she had been cast adrift, sank down in a swoon. Then the truth became known to her concerning the treachery of King Alla's mother; and, husband and wife being reconciled, Constance made herself known to her father, the Emperor; so at last all were come to happiness.

Alla shortly after took his wife back to England. But only a little while in joy and pleasure lived Alla and his Constance before Alla died.

Constance then returned, for the last time, to Rome, where Maurice was made Emperor in course of years; and the remainder of her days were passed in acts of virtue and charity.

THE MEN WHO WENT TO KILL DEATH—THE TALE TOLD BY THE PARDONER

In those days there were men who were permitted to sell to others, in the name of the Pope, "pardons" for their sins. Such a pardon was known as a "papal indulgence." The men who sold these were called "pardoners." Here is the story told by the pardoner whom Chaucer includes among his pilgrim group:

In Flanders lived a company of young revelers who practised all forms of folly and wickedness. Three of these ne'er-do-wells were one day seated in a tavern drinking, when a bell was heard tolling for a man who was dead. One thereupon called out to his servant to get for them the name of the dead man. The varlet replied that he had no need to go out to learn who it was that was dead.

"It was," said he, "told me two hours before you came here. The dead man was an old comrade of yours, and he was slain at night as he sat on his bench drinking by a silent thief men call Death, who hath killed a thousand of pestilence in this country."

The lad's story was confirmed by the taverner, who added that Death had that year slain men, women, and children, peasants and pages, within a great village a mile away.

At this one of the roysterers invited his fellows to join with him that they might seek out Death and slay him. And the three set out on their errand toward the village spoken of. On their way they met an old man, who besought their mercy.

"Nay, old churl," said they, "tell us where this same Death is, that killeth all our friends, or thou shalt die."

"Now, sirs," replied the old man, "if thou art so eager to find Death, turn up this crooked way, and you will find him in yonder grove beneath an oak-tree, where I left him."

On learning this the three rowdies ran in the direction indicated, and, coming to the tree, found a great store of golden florins piled up. No longer did they think of their quest of Death, but forthwith sat down by the precious hoard.

"Fortune," said the youngest of the three, "has given us this treasure that we may live in mirth and jollity. It must be carried home to my house or to yours by night, because if men saw us with it in the daytime we should be hanged for carrying what is our own."

He proposed that they should draw lots to decide which of them should go to the town for food and wine, while the other two kept watch over the treasure. The lot fell on the speaker. When he had departed, one of the others said to his companion that it would be so much better if the gold were divided only between two of them.

"Two of us are stronger than one," said he, "and when our companion returns do you engage him, as it were, in a playful wrestling bout, when I will strike him with my dagger, and if you despatch him with yours, then all this gold shall be ours to gratify all our wishes and enable us to play at dice as much as we like." The second villain agreed to this dastardly plan. But wicked thoughts entered also the mind of the youngest as he went toward the town, and, thinking how he could gain the gold for himself, he bethought him of the apothecary's, where on the pretext that he wanted to kill rats, he bought some powerful poison. Next he borrowed three bottles, into two of which he poured the poison. Filling then the bottles with wine, he returned to his companions, to whom he purposed giving the poisoned wine, drinking himself from the third and harmless bottle. When the other villains had killed him, as they had planned to do, they said, "Let us sit down and drink and make merry before we bury him." And one, taking up a bottle—it was one containing poison—drank from it and passed it to his companion, who also drank.

So, both dying of the poison, the words of the old man who had told them that they would find Death under the oak-tree were proved to be true.

THE ROMANCE OF THE LADY EMELYE —THE TALE TOLD BY THE KNIGHT

Once upon a time in ancient Greece lived a great duke named Theseus. No greater conqueror than he lived under the sun. He defeated the Amazons of Scythia, and married their Queen, Hippolyta, whose fair young sister, Emelye, he took captive. On his way back to Athens he was met by weeping women, who besought his help, because the tyrant Creon had massacred their husbands and captured the throne of Thebes. Sending Hippolyta and Emelye to Athens, Theseus turned aside, and with his army marched on Thebes. There he slew Creon by his own hand, and routed the tyrant's forces.

After the battle there were found, wounded and lying near where the fight had been fiercest, two handsome and richly dressed young men, named Palamon and Arcite, cousins of the royal house of Thebes. Now, because of a vow he had made against Creon's house, Theseus ordered these young men to be kept in prison at Athens for life. When they had recovered from their wounds, Palamon and Arcite were therefore thrown into a dungeon in a strong tower near Theseus's palace in Athens, where they remained captive for several years.

It also happened that the narrow window of their dungeon overlooked the royal garden, and here, one bright May morning, the Lady Emelye—

Far fairer to be seen
Than is the lily on her stalké green,
And fresher than the May with flowers new,

came forth to walk and gather flowers.

Her yellow hair was braided in a tress,
Behind her back a yardé long, I guess . . .
And as an angel heavenly she sang.

Palamon himself awoke with the sun, heard the sweet song, and, peering through his prison bars upon the fair scene beneath, was stricken to the heart with love for the fair Emelye. His cry of pain aroused Arcite.

"Cousin mine," exclaimed Arcite in alarm, "what aileth thee? Why criest thou? Take in all patience our imprisonment, for the stars ordained it when we were born."

"Cousin," replied Palamon, "you are wrong. It was not our imprisonment that caused me to cry out. The fairness of the lady that I see yonder in the garden is the cause of my woe. I know not if she be woman or goddess in human form."

Then went Arcite to the narrow window, and when he too saw Emelye walking in the sunlight his despair was even greater than Palamon's.

"If," he cried, "I cannot see her day by day, I shall be naught but a dead man." Then, for the first time in their lives, there sprang up a feeling of enmity between the cousins.

This continued till one day a duke who knew Arcite, and who was an old and valued friend of Theseus, came to Athens, and, hearing of Arcite's captivity, begged Theseus to set the young Theban free. The request was granted on the condition that Arcite went his way, consenting never again to set foot on Athenian soil. For two years Palamon, still in prison, and his cousin, now at liberty, bewailed the cruel fate that divided them from the beautiful Emelye.

At last Arcite could bear his pain no longer, and returned to Athens as a poor laborer. In this guise he obtained a humble post in the household of the duke, where his manners soon won him advancement. Then, one night, Palamon was enabled to drug his jailer and to escape to a little wood near by, where he met Arcite, and the two fell to quarreling afresh over the object of their mutual affection. At length Arcite said he would bring food and weapons, so that on the morrow they could fight for the lady Emelye.

They were engaged in this conflict when they were surprised by Theseus and his retinue. Theseus, learning from Palamon who they were, condemned both to death, but on the intercession of the ladies of the company he ordained that the two rivals should go away for fifty weeks, at the end of which period each should return with fifty knights, to attend a great tournament, the victor in which should have the fair Emelye's hand.

The time passed, and when the hour of the tournament arrived it was decreed by Theseus that life should not be wasted, but that should either of the leaders be taken prisoner or slain the tourney should cease. Palamon was struck down by the Indian King Emetreus in Arcite's company, and taken prisoner; but as Arcite was riding proudly to the spot where Emelye was sitting his horse stumbled, and he was fatally injured by the fall. Whilst lying at the point of death in the palace of Theseus, Arcite sent for Emelye and Palamon. To Emelye he said:

"Nought may the woful spirit in mine heart
Declare a point of all my sorrow's smart
To you, my lady, that I love most;
But I bequeath the service of my ghost
To you aboven every creature,
Since that my life may now no longer dure.
Farewell, my sweet! Farewell, mine Emelye!
And softly take me in your armés tweye [two],
For love of God, and hark to what I say.
I have here with my cousin Palamon
Had strife and rancour many a day i-gon [gone by],
For love of you, and eke [also] for jealousy."

But, he went on to say:

"In this world right now I knowé none
So worthy to be loved as Palamon,
That serveth you, and will do all his life.
And if that ye shall ever be a wife,
Forget not Palamon, that gentle man."

And so a brave man died. Emelye and Palamon were stricken with bitter grief, and Arcite's death was mourned by all Athens. Even the Duke Theseus bowed his head in sorrow. None could comfort him save his aged father, Egeus, "that knew this world's changes," and who said:

"This world is but a throughfare full of woe,
And we be pilgrims, passing to and fro;
Death is an end of every worldly sore."

Theseus cut down the wood where the cousins had fought, and gave to Arcite a befitting funeral. Then it came to pass, when time had brought healing to the hearts of all concerned, that Theseus sent for Palamon and Emelye, and, that of two sorrows might be made a perfect joy, the duke ordered that these two should take one another as husband and wife.

So, with great rejoicing, the marriage was celebrated, and Emelye loved Palamon so tenderly, and Palamon served Emelye so nobly—

That never was there word between them two
Of jealousy, nor of none other woe.

THE KNIGHT AND THE UGLY OLD WOMAN—THE TALE TOLD BY THE WIFE OF BATH

A KNIGHT of King Arthur's court, by an unworthy deed, had earned the penalty of death. But, the Queen and her ladies gaining the King's grace, the knight was handed over to the Queen, who promised him his life if, within a year and a day, he could tell her what it was that women most desired.

Time passed sorrowfully for the knight. No satisfying answer could he discover of any one. Then, when the day on which he was once again to appear before the Queen drew near, and he was returning from his quest, he met an ugly old hag, who, addressing him, inquired what it was that he sought.

"Promise me," said the old woman, when he had told her his story, "that you will do the next thing that I require of thee, if it be in thy power, and I will tell thee the answer."

The knight gave her his word, and together they journeyed to the Queen's court. Here, as instructed by the old woman, the knight declared that the thing most desired of women was power. This was the answer, and he was adjudged to have saved his life.

Then up rose the old woman, and, telling the Queen of his promise, asked his hand in marriage.

"Take all my goods and let me go rather!" exclaimed the knight. But he was kept to his bond. When his newly wedded wife upbraided him for his treatment of her, he taunted her with her lowly birth, as well as her ugliness and poverty. To this she replied in words that have been full often repeated:

"Look who that is most virtuous alway,
Open and secret, and most intendeth aye
To do the gentle deedés that he can,
And take him for the greatest gentleman.
Christ will we claim of him our gentleness,
Not of our elders for their old richesse.
For tho' they give us all their heritage,
For which we claim to be of high peerage,
Yet may they not bequeathé, for no thing,
To none of us their virtuous living,
That made them gentlemanly calléd be,
And bade us follow them in such degree."

When the knight had repented him of his unknightly mood, his wife asked him to choose which she should be—as she was, old and ugly, but devoted to him, or young and fair, but vain and fickle. In reply the knight put himself in his wife's "wise governance."

"Then," said she, "I have the mastery. And I will be to you both fair and true."

The knight, looking up, now saw, to his rapture, that what she said had come to pass. And the two lived to their lives' end in perfect joy.

THE DEAD BOY WHO SANG A HYMN—THE TALE TOLD BY THE PRIORESS

It must be borne in mind in reading this tale that at the time to which it relates there was a great hatred between Christians and Jews. Both misunderstood one another, much as they do in Russia to-day; and few perhaps of Chaucer's pilgrims would have known enough to cast serious doubt on the truth of the prioress's story, which was an old fable that may be briefly told:

Once, in a great city of Asia, was a quarter filled with Jewish money-lenders. The street in which the Jews lived was one through which was constant traffic. At one end of this street was a little school, to which Christian children went. Among these children was a widow's son, seven years of age. He had learned at his mother's knee to pray, and when he heard the hymn "Alma redemptoris" (Mother of the Redeemer) sung, so moved was he that, though he knew no Latin, he soon learned to repeat the first verse. Then he asked another boy to tell him the meaning of the hymn, which finally he learned by heart, and grew to love it so much that he sang it regularly as he went to and from school through the street where dwelt the Jews.

Satan then stirred the hearts of the Hebrews against the little singer, and they hired a wicked man to kill him and cast his body into a pit. The next day the widow sought everywhere for her son, and made piteous but useless appeals to all the Jews to tell her if and where they had seen him. They all said "Nay."

But Jesus of his grace
Gave to her thought, within a little space,
That in that place after her son she cried,
Where he was casten in a pit beside.

And hereupon the dead child began to sing the "Alma redemptoris" so loudly that all the place began to ring. The Christian folk passing through the street stopped to wonder at this marvelous thing. They sent for the provost, and he, praising God for the miracle, had all the Jews taken and bound, and the child's body carried to the nearest abbey.

The guilty having been punished, preparations were made for the burial of the child. All the time the voice of the boy was heard singing the hymn he loved so well.

"Dear child," said the abbot, "I conjure you, tell me why you sing, since that your throat is cut."

And the child replied that as he was about to die, Mary, the mother of Jesus, appeared to him and placing a grain upon his tongue said he would continue to sing, till from his tongue this grain was taken.

The abbot then took away the grain, and the boy "gave up the ghost full softily." Every one was thereupon deeply moved. And the little martyr's body was placed in a marble tomb.

INTERESTING QUESTIONS AND ANSWERS

WHERE DOES THE RAIN GO?

Many things happen to the rain that sinks in the earth, and exactly what happens depends largely on what the surface of the earth is like at that particular place. A great deal of the rain remains in the soil to the depth of some feet, as soil water or ground water. If there is no such water there can be no vegetable life. But in places where rain falls, and the ground holds some of it, there we are sure to find plants of various kinds, that suck up a good deal of this water into themselves by their roots, and then give it back to the air. The soil also contains all sorts of life of other kinds besides green plants, such as various kinds of animals, like worms and insects, and also countless numbers of microbes. All these take up and use for their lives some of the water that the rain gives to the soil.

But still a great deal of the rain is not used up in any of these ways. Much of it is sucked up again into the air by the sun's heat, when the rain stops falling. Much of it also goes on sinking slowly through the earth until it reaches a layer of something that it cannot sink through. It may be carried on this layer to some lower level, where it may bubble up out of the ground as what we call a spring. In the long run almost all the rain that is not kept by living things, or given back to the air at once, gets into streams and rivers, and into the sea, where the sun sucks it up to go on its round again.

WHERE DID ALL THE WATER IN THE OCEANS COME FROM?

We might at first think, if we remember how all the rivers run into the oceans, that rivers bring the water. But, after all, just as much water as the rivers bring is caught up by the sun into the air; and the amount of water in the sea is, in any case, too great for the rivers to account for. By far the greater part of the water in the oceans is what we may call the original water of the world, which has gathered in the ocean-beds because they are the most convenient places for it to be in, under the influence of the earth's gravitation. The water, as we know, was long ago held in the air when the air was much hotter than it is now. But, of course, it is right for us to ask where it came from even before it fell upon the earth and helped to form the oceans. The answer is that it was made ages ago by the burning of hydrogen with oxygen. Elements cannot combine with each other in intense heat, and so before the water of the world was formed it was very hot, and hydrogen existed separately, though there was plenty of oxygen near it. As the earth cooled a little, however, it became possible for hydrogen and oxygen to combine, which they did, forming water. There is vastly more oxygen than hydrogen in the world, as we know, and most of the oxygen which was left over when the hydrogen was burnt up to form water is to be found in the atmosphere still.

HOW IS IT THAT THE WATER OF THE SEA DOES NOT SINK INTO THE GROUND?

Wherever it can, water does sink into the ground; and where the sea is deep, the pressure of all the water above will force the water at the bottom into the ground if it can possibly go there. It is probable that in most places the ground of the sea is of a very dense kind which water cannot penetrate as a rule; but often things may happen to it that will allow some water to pass through, and then, when that water reaches the hot levels of the earth's crust, it is turned into steam, and may make a great disturbance. We always think of earthquakes as things that happen on the dry land, but we know that earthquakes also occur in the bed of the sea. When a very powerful earthquake occurs in the bed of the sea, and a great deal of water sinks in and is turned into steam, we get what may be called a seaquake, and there is little doubt that some of the strange and terrible things which the sea does are caused in this way.

But we must suppose that, on the whole, the bed of the sea is not so easily penetrated by water as many parts of the dry land are, and that is perhaps one reason why it has become the bed of the sea. Instead of letting the water run through it, it holds the water upon the top of it, as the bottom of a basin does, and then the weight of the water gradually helps to force it down and make it cup-shaped, so that it will hold still more water. But we cannot be at all sure about this, for it is a very difficult thing indeed to find out.

IF THE EARTH'S CENTER IS A BALL OF FIRE, WHY DOES IT NOT BURN UP EVERYTHING?

When we say burn or consume, we mean combine with oxygen. So, if there is no oxygen in a place, burning cannot go on. The things there may glow, and be intensely hot, but they cannot burn—which is to combine with oxygen—for there is no oxygen at all for the things to combine with. That is one answer to our question, but here is another. Very nearly the whole of the outside of the solid earth is already as burnt as it can be, and so is all the water of the oceans. However hot we make them, and however much oxygen we have, we cannot burn water or sand or flint or clay or gravel, for these things are already burnt. When the elements of which they are made have combined with all the oxygen that they are capable of combining with, then they are as burnt as they possibly can be. Thus, the whole exterior of the earth, with only very scattered and slight exceptions, has already been burnt up, and what we call the earth and the sea are the results of that burning. This burnt crust now encloses the fire in the center of the earth, and keeps out the oxygen of the air—the oxygen which has been left over, so to speak, from what has been used up in burning the crust of the earth.

WHAT WAS THERE IN PLACE OF THE EARTH BEFORE THE EARTH WAS FORMED?

Astronomers are not quite certain as to the details of the matter that existed in space before the earth was formed, and that gradually turned into the earth. This matter, indeed, probably passed through various stages rather different from each other. The simplest view, and one which is almost certainly true in the main, is that the last stage passed through before the earth was formed was that of a mighty cloud of glowing gas. It must have been very hot, for we have proof of that in the rocks, and in other ways; and as it was hot, it must have occupied a great deal of space. The earth upon which we live now is very small compared with that globe of gas, but, on the other hand, it is very much denser—for the earth has been steadily shrinking for countless ages, and we know that it is shrinking still. We may ask how it was that this great globe of gas came into being. We know that it did so by separating itself from the great mass of which the remaining central part is our sun. The other planets were formed in the same way, and so we find the same matter in the earth, and in the other planets, as we find in the sun. This globe was a little sun, indeed, as the great hot planet Jupiter is still; it was so hot that it must have given out light of its own.

WHAT HAPPENS TO THE LIGHT WHEN IT GOES OUT?

We have to think of light as a kind of energy, a kind of disturbance full of power that is made in the ether. It is a thing that travels at a tremendous speed, and it is not capable of being still. When we have a steady light in a room, it is not that there is something in the room called light which is staying there, but that from every millionth part of a second to every next millionth part of a second new light is being steadily made. So we cannot keep light in a room as we keep anything material. If, for instance, we take a heap of sand into a room and then, putting it in a heap on the floor, do no more, it stays there until something removes it; but light stays nowhere, it is always moving; and if there is to be steady light in any place, there must be a steady source of light to produce it from moment to moment, or it will cease.

When we darken a room we cut off the source of light, and the light which was made an instant before is gone. Now we see why. Nothing is lost, and the energy or power that made the light is not lost, even though the room is quite dark. If we could trace it we should find that it had been transformed into other things; it is transformed into heat, which we find in all the matter which it strikes—and this includes not only the furniture and walls, but also the air of the room; it is also changed into the power which starts chemical changes, as, for instance, when carpets and curtains gradually fade under its influence.

HOW FAR DOES A STONE FALL IN THE FIRST SECOND?

We know exactly the answer to this question. We might think at first, if we read the answer to the last question, that the stone must fall 32 feet. But 32 feet is the amount of increase in the rate of its falling at the end of a second, and at the beginning of the second the stone was not moving at all. Therefore, its average rate of movement throughout the second is midway between no movement at all and 32 feet—in other words, an average of 16 feet per second. That is what we find; at the end of a second the stone has fallen 16 feet.

If falling things did not fall quicker as they fell, it would hurt us no more to fall five hundred feet off a high cliff, or to fall thousands of feet from a balloon, than to fall to the ground when playing a game. The farther a thing falls, the more quickly is it moving when it reaches the ground, and the greater is the force with which it strikes the ground. If there were nothing to resist the fall of objects, there would be nothing to prevent this increase in speed getting greater and greater; but there is always the resistance of the air, and in the case of the fall of raindrops, that is sufficient to hold them back. If it were not for this, a raindrop falling on our head might fall with such terrible force as to kill us. The proper name for the increasing speed of a falling body is *acceleration*, and we shall remember not to spell it was two "l's" if we know that it comes from the Latin celer, *swift*. The acceleration due to the pull of the earth, which we call gravity, is the same for all falling bodies. It is not greater for a heavier thing than for a lighter. Galileo showed this when he dropped two balls, one light and one heavy, from the leaning tower of Pisa, and they reached the earth at the same moment. The amount of this acceleration has been precisely measured. It is 32 feet in every second of time—that is to say, the falling body in each second falls 32 feet more than it did in the second before.

WHAT IS IT MAKES US FEEL HUNGRY?

Most people confuse some very different kinds of things together, and call them all hunger, but that is a very bad and a very serious mistake. When a man has had a good dinner, and has perhaps eaten more than he should, and then eats a chocolate, or drinks a glass of liqueur, or takes a crystallized fruit, he is doing something which may, or may not, be quite harmless; he is taking something that he likes, but what prompts him is certainly not hunger. We eat and drink a great many things at meals, and between meals, just because they are pleasant to our senses of taste and smell. These senses like to be pleased, just as our other senses do; but we no more satisfy hunger by taking a pleasant sweet because it has a nice taste and smell than we do by listening to singing.

Real hunger is quite a different thing, and the place where it really is caused is not either in the mouth or in the nose. A person who is really hungry will eat dry bread, or tasteless oatmeal porridge, without milk, cream, or sugar, and he will find it delicious. Real hunger is a state of the blood. The blood has used up much of its food material, and needs more. As it passes through the brain, the brain—which is where we feel everything—finds that the blood has not sufficient food materials in it, and it sets the body asking for more. That is true hunger, and if we ate only to live, we should eat only when we had this true hunger. If we eat too much, or without being hungry, we eat to die in the long run.

WHY DO WE COUNT IN TENS?

You may well ask why we count in tens, for it would be much more convenient if we counted in twelves—if we had a *duodecimal* system of counting in twelves instead of a *decimal* system of counting in tens. I mean that we should invent two extra single figures for ten and eleven, and then write ten to mean twelve, and eleven to mean thirteen, 100 to mean 144 (twelve times twelve instead of ten times ten), and so on.

I believe we shall all do this some day; and the reason is that, while ten can only be evenly divided by two figures, two and five, twelve can be evenly divided by four figures. Thus, for many purposes it would be better to count in twelves, and, indeed, we often do so, as when we count twelve inches in a foot and twelve eggs in a dozen. This would also fit in nicely with the number of months in the year. But we count in tens still, as a rule, and we shall doubtless do so for many a long day yet, simply because our ancestors have always done so.

If you think how you sometimes used to reckon when you started arithmetic, you will guess the simple reason why. It is because we have ten fingers. When we count on our fingers, as children do, and as the first men did, it is natural to make a fresh start after ten, because then we go back again to the finger we began with. So all over the world, and in all times and places, we find men counting by tens—using a decimal system, as we say—just because men and women everywhere have ten fingers.

ARE THERE ANY PEOPLE IN THE OTHER WORLDS?

This is a great question, to which no one can return a certain answer, and about which many big books have already been written and many more will be written. But something we can be sure of. People sometimes talk as if there could be *men* on other worlds, but we may be sure, when we think of the wonderful way in which men are adapted to this earth of ours, to its air, and water, and climates, and food supply, that there could be men like ourselves only on a world *just like ours,* and we certainly do not know of the existence of any such world. Those we know all differ greatly from our earth in all sorts of most important things, such as the composition of the air. *Man,* then, is a child of earth—this particular earth of ours; he is exquisitely fitted for it, and it for him, not only in its air, and soil, and oceans, and heat, but also in the kind, and the balance, as we may say, of the thousands of animals and plants that inhabit it with him. We are certain that men and women and children like ourselves could be found only here, or on some other world, unknown to us, which is an exact double of our earth. Such a world is quite unlikely to exist anywhere.

WHY ARE ALL OUR FINGERS NOT THE SAME LENGTH?

It might be very difficult to answer this question if we had only the present use of the hand to account for; and it is a disadvantage to us that our little fingers and ring-fingers, for instance, are so short and weak, for this weakens our grasp of things, which is the principal purpose for which we use our hands. Also, this inequality of the fingers in length and strength is a difficulty for the pianist and the typist. We therefore cannot hope to answer this question by referring to the usefulness of the hand for its present purpose. But we find the answer when we consider the history of the hand, and when we look at the fingers of many kinds of lower animals which have fingers more or less like ours.

We learn that our hands were originally used for standing and for walking, since we inherit them from "four-footed ancestors." If we put the hand on a table, as if we meant to walk on the tips of the fingers, I think we shall see at once what a well-balanced support it makes, just because the fingers are unequal in length—the middle finger the longest, and the short thumb and little finger falling behind and balancing the whole. We see the same thing at the zoological garden in the case of animals that have three fingers—as the toes of the forefeet might rightly be called—and we can notice it for ourselves any day in the dog or the cat. This is only one instance of a very large number furnished by our bodies which help us to understand why certain things, for which we can find no particular reason now, and which may even be inconvenient to us, are as they are.

WHY ARE WE GIDDY WHEN LOOKING DOWN FROM A GREAT HEIGHT?

Every one does not become giddy when looking down, and any one who is in good health can learn in time by practice how to look down from a height without turning giddy. There are two explanations of this giddiness. One is the general explanation that the fear of falling disturbs the working of the brain. Now, our sense of being balanced, and our feeling that we are able to balance ourselves, depend upon the proper working of the brain; and so the fear of falling may make us giddy, just as giddiness may be caused at times by other kinds of fear.

But people who are not in the least afraid, or who did not at all expect to be afraid, may turn giddy when they look down from a height, and there is a very interesting explanation of this. Part of our power of balancing ourselves depends upon vision. We know how one is apt to bump against a companion when walking at night, for instance. And even though we can balance ourselves without the aid of sight, yet we are very apt to feel giddy if our eyes play us any tricks, and that is what they do sometimes at a height.

CAN THERE BE ANY KIND OF INTELLIGENT LIFE ON MARS?

It is almost certain that there is life of some kind on Mars, and some people believe there are thinking beings on Mars—not men, yet beings who might understand men, and whom men might understand when they got to know each other's way of expressing themselves.

Some people who have given their whole lives to the study of Mars are quite certain that there are marks upon its surface which only intelligent beings could have made, and are even sure that all the "Martians" must be one great family who live in a friendly way, and have given up fighting each other as men still do, for the marks on Mars, it is thought, could only have been made by a race of beings who had given up wars and frontiers, and quarrelling, and worked all together for the good of all. Perhaps the children who read this answer may live long enough to learn for certain what is the truth about the "canals" of Mars, and how they came to be made. There is scarcely a more interesting question in the world.

HOW CAN PLANTS GROW ON A BARE WALL?

ONE of the most important parts of the food of green plants is found, as we know, in the air. That is the carbonic acid gas, which provides the plant with its carbon. But that, of course, is not all. The plant must have water, and it must have salts. Now, a bare wall is not as bare as we think it, when we come to examine it closely. In the first place, rain falls upon it, and so the plant gets its water. Nor is this all. Rain itself contains minute quantities of salts which are valuable to the plant; and as it trickles down the wall, it gains more. It has the power of melting, out of the wall, salts that may be contained, for instance, in the mortar. We know that lime is very valuable for plants, and mortar is really a kind of lime. So we find on examination that plants can obtain, even growing on a bare wall, those things that are necessary for their life. But, of course, the supplies of certain essentials are very scanty, and the forms of plant life which can grow in this fashion are very humble, and never reach a large size. Very different is the case of the plant that grows over the bare wall, but has its roots in the earth, from which it draws nourishment.

WHY WON'T A THIRD TOOTH GROW?

WHEN we are born we have, hidden in our gums, all our first, or *primary*, teeth. These twenty teeth are already completely formed in all their parts at birth, and only have to get through the gums in order to be seen. A baby gets its food by sucking and not by biting, and so it is really better that its teeth should be out of the way at first, below the gums. Still deeper in the gums, below each of the primary teeth, and also farther back in the jaw than the primary teeth extend, there are little groups of cells, called tooth-germs, which will some day make the second set of teeth, usually called the *permanent* teeth, though they are often not as permanent as they might be. There are thirty-two sets of these little cells; and though none of them are teeth, or look in the least like teeth, they have in them the power of making teeth of the various kinds that we possess.

We should take very great care of the first teeth of children, brushing them, and having them filled if they decay, even though we know that they will fall out soon, because if they are neglected the tooth-germs underneath them are very apt to be injured, and when the new teeth come they will be irregular, or have thin, soft, crumbly outsides, which easily break away or decay. Now we see why a second tooth grows when the first falls out or is pulled out. But no third tooth will grow when a second tooth has been lost, because there is no other tooth-germ lying below the second tooth, as there is below the first tooth. Thus a third tooth cannot grow because there is nothing for it to grow from.

WHY DOES WOOD ROT AWAY?

WELL, there are kinds of wood that will not rot away, even though they are kept in water. The ancient city of Venice is actually built on wooden piles buried in the shallow sea; and these have lasted for many centuries already. This wood does not rot because the things that make wood rot cannot attack it, and wood does not rot without a cause.

We shall begin to guess what it is that makes wood rot when we learn what is done to wood that must be exposed to wet and yet must not rot—for instance, the wood of which railway sleepers are made. These are often soaked with a chemical substance called *creosote;* and the particular property of creosote which makes it so valuable is that it is poisonous to microbes. So the answer to the question, in one word, is *microbes;* and wood will not rot if it is charged with something that kills microbes, or if it is made of stuff so hard and tough that even microbes cannot digest it; or if, as in the case of Venice, it is very good wood, and also protected from the kinds of microbes that can rot wood by being kept in salt water.

WHY ARE SOME PEOPLE DARK AND SOME FAIR?

THE differences of color between various people are a good instance of those many differences which are due not to anything that happens to us in the course of our lives, but to something that is inborn in us, and usually derived from our parents. The children of two dark parents are dark, those of parents who are both brown-eyed are always brown-eyed, and so on. This way in which people resemble their parents is one of the most important things in the world, and the special name for it is *heredity*. We say that the thing in question, such as skin-color or eye-color, is *hereditary*.

All human beings may be divided into races by their color—the fair-skinned, the yellow-skinned, and the dark-skinned; and they are all apt to think the others ugly. In the United States there is a great mixture of races, though the majority belong to the dark-skinned family of mankind. Among us are a fairer and a darker race, and it is known that at present, owing to some reason we do not understand, the darker people are increasing and the fairer people are becoming fewer. It is probable that, ages ago, differences in color depended partly on the amount of sun, darker people having coloring matter in skin and eyes which protects them from strong sunlight; but this is a question about which we do not know much yet.

WHY DOES A RIVER CURVE AND TWIST INSTEAD OF RUNNING STRAIGHT?

The course of a river-bed entirely depends on the lie of the land. If this changes in course of time, the course of the river will change. The water runs downward to the sea, pulled by the earth's attraction as near as it can get to the center of the earth. It must run just as a ball would run on an irregular surface. Thus, sometimes, where the earth falls evenly, like a tilted table, a river will run quite straight; but if there is a little hillock in the way the river will run round it.

When we notice the ordinary curves and twists in the course of a river, we may see no good reason for them, for all the land may look equally flat. But that is only because we cannot, with our unaided eye, see accurately enough. If we use a special instrument to show us "how the land lies" at any point, we shall find that the river is really doing the only thing it can—running downward all the time.

WHY DO THE BEDS OF RIVERS CHANGE?

The earth's crust is shrinking all the time, as the interior cools and shrinks beneath it. This means that the lie of the land changes from age to age, and one consequence of this—it has many and great consequences—is that often the water of a river finds that its steepest and quickest course to the sea is different from what it used to be, and so the river-bed changes; the old one is deserted by the waters, and a new one is formed.

But the water itself, as it flows, rubs and melts away the earth it flows over, and so grinds a deeper and ever deeper bed for itself. Thus it gets less and less likely to desert its old bed the longer it flows there. In many parts of the world we can see how water has hewn a path for itself, even through solid rock. The railway engineer wishes to avoid carrying his trains uphill, just as the river water wishes to avoid traveling uphill; and so the engineer often bores a tunnel, rather than make the trains run out of their course. Sometimes the river does the very same thing. A train cannot cut a tunnel for itself, but sometimes water can, and then we have a river running underground.

WHY HAVE WE TO DEVELOP PHOTOGRAPHS IN A RED LIGHT?

We know that white light is really a mixture of light of all sorts of colors—red, yellow, green, blue, and so on. Some of these lights of various colors have one kind of power, and some another. For instance, red light has far more heating power than violet light, which has practically none at all, while red light will soon show its power on a thermometer. Now, the kind of light that has the power of causing chemical changes, which is the light we see specially by and the light we photograph by, is mainly violet light, or the violet part of white light. We can see, in a way, by red light; but red light has practically no influence on photographic plates. We may say that photographic plates cannot see red light, and so we can use red light to develop them by, without fearing that they will be "fogged," which would happen were they exposed to a white light of any kind.

WHAT IS A VACUUM?

Vacuum is simply a Latin adjective meaning *empty*, and we have an English word, *vacuous*, which has the same meaning, and which we sometimes apply to the expression of a person's face when it seems to mean nothing—to be *empty* of meaning. In the study of Nature we often talk about a vacuum, meaning by that an empty space. It is always necessary to remember that there is really no such thing as empty space, for what we call the *ether* is everywhere.

But when we speak of a vacuum we are leaving the ether out of account, and are simply thinking of gases, such as the air. We talk such a thing as a globe of glass, which cannot collapse when the air is sucked out of it—a paper bag would not do, for when we suck the air out of that the air-pressure outside it makes it collapse—and we attach a pump to it, so as to suck out of it all the air we can. When we have done so, we call the space inside the glass globe a vacuum. As a matter of fact, we can never get a real vacuum, but only a space which contains comparatively little air. Even if we have a perfect pump that cannot leak—and I am sure I do not know where to find such a pump—and even if we work it for a thousand years, each time sucking out some of the air that was in the globe, we shall *never* have a perfect vacuum; only what is called a very *high* vacuum.

WHAT MAKES THE RAINBOW?

The rainbow is made by drops of rain; it is due to the reflection of sunlight from drops of water hanging in the sky. As the sunlight passes through the raindrop, and is reflected from the inside of the back of the raindrop, it is broken up into its various parts, which correspond to the various colors of the rainbow.

White light, we know, is a mixture of many colors. The light waves corresponding to these colors differ in the extent to which they are bent by passing through such a thing as a raindrop, and so, when they come out of it, they are sorted out, so to speak; and what was white light on going in, comes out as a band of several colors. Thus, what we see in the rainbow is really a natural spectrum of sunlight—the light spread out in a band of the various colors that make it up.

As we trace the rainbow down on each side it seems to touch the earth, and there are stories of children who have set out to find the end of the rainbow. But the rainbow ends nowhere, for it is a mere appearance in the sky, due to tiny drops of water, and it "ends," if we are to use that word, simply where the drops of water end that are so placed as to reflect the sunlight in this way to our eyes. Really no two people see exactly the same rainbow. They could not do so, unless their eyes were in the same place. And as we move, the bow we see moves with us.

WHAT IS IT THAT HAPPENS WHEN WE GET TIRED?

The special word for feeling tired is *fatigue*, and this state of the body, as it often is, and of the mind, as it often is too, has been very carefully studied during the last few years, especially in Italy. We have learned a great many very interesting and useful things about it.

We know that the power and energy of the body come from our food; and so the first idea of the cause of tiredness or fatigue was that it was due to the need for more food. The tired person, people thought, had used up his food and needed more; just as a railway engine might be said to get "tired" if the fireman forgot to supply it with plenty of coal. If this were true, the more utterly exhausted and "dead beat" a man was, the bigger the meal that he should take in order to make him feel fresh again.

But we have learned that this old idea was utterly wrong. The body always contains so large a supply of food material or fuel that a man gets tired, for some other reason, long before he has nearly used it up. Also we have learned that, in the state of fatigue, it is not possible to digest one's food properly, and therefore that to give a large meal to an exhausted person is very bad indeed for him. He is not fit to use it, and it only upsets him. We should eat only very slightly and carefully, if at all, when we are very tired. The best thing for tiredness is rest, and the best kind of rest is sleep.

In general, the people who sleep best are those who work hard. The man who works all day in the fields usually has the best sleep in the world, far better than some unfortunate people who do very little or nothing, and who may even take medicine to help them to sleep. Nature, the best of all doctors, has her own medicine to procure good sleep for every healthy person who works; and the most beautiful thing about tiredness, when it is the right, "nice" tiredness that every one should feel when he goes to bed, is that it produces in our blood just the very thing that gives us perfect and natural sleep. Perhaps we shall soon be able to find this thing, and learn how to make it. Then we shall be able to give just the right quantities of it to make ill people well.

WHAT IS THE BIGGEST SHADOW THAT WE CAN SEE?

There is one great shadow, thousands and thousands of times bigger than any other, which men have noticed at times in all ages, and which has often made them very much afraid. This is the shadow of the earth itself, and it is thrown upon the moon. It sometimes happens that the earth just gets in the way of the light from the sun which would fall upon the moon if the earth were not there. And so we get what we call an eclipse of the moon. As we watch the moon, we can see a round shadow beginning to creep across it.

Sometimes it passes over only part of the moon; sometimes it covers the whole moon for a little while, and we call that a total eclipse of the moon. When we watch this shadow—one does not even need a glass to see it with—it is easy to see that the shadow is curved. It is the shadow of a round thing, and this is one of the proofs that the earth is really round. In olden days men used to be very much afraid of eclipses of the moon and of the sun. They used to think that it was a warning of something awful that was to happen. But now we know that an eclipse of the moon is nothing more than just the throwing of a great shadow upon the moon's face, and that is the shadow of the earth, by far the greatest shadow that any one can ever see.

WHAT IS THE MILKY WAY?

Students of the stars think that the Milky Way is the boundary of our world of stars. It is a complete closed circle where the sky is crammed with stars; yet in places there are gaps where we can see through beyond into nothing. We can begin to measure the diameter of this great circle. Our own sun and his system seem to be somewhere near the center of it, and a very remarkable thing about the sun, and therefore about us, seems to be that he is very much alone in the world of stars. He has no near star neighbor, while most of the other stars are much more neighborly, especially throughout the whole circle of the Milky Way. We cannot tell at all whether the whole Milky Way is moving through space, and we do not know whether it is moving round on itself; but we can study and photograph it now, and long years afterward our successors may compare our photographs with what they then see, and may be able to learn about these things.

WHY DO SOME FACES IN PICTURES SEEM TO FOLLOW US?

Perhaps you have also noticed that in other pictures there are faces which are not looking at us; but no matter where you walk, even though it be in the direction in which they seem to be looking, you will never find the face looking at you. Indeed, faces in pictures are either looking at us, wherever we look at them from, or else they are never looking at us, wherever we look at them from. The same is true of photographs.

The rule is very simple. If the person who was being painted or photographed was looking at the painter or at the camera, then, wherever you stand, he will seem to be looking at you If he was looking on one side, then, wherever you stand, he will seem to be looking on that side of you. This works very queerly if you have a group of people who were all looking at the camera when they were photographed. If you look at the photograph from one side, they all seem to turn to follow you, and then to turn back if you look at it from the other side. But if they were not looking at the camera, you can never get them to look at you.

WHY DO THE TELEGRAPH LINES HUM?

Anything that is stretched is apt to be thrown into vibration, or made to tremble, by the force of the air blowing against it. If it vibrates so fast as to produce the air-waves that our ears can hear, then that is what we call sound. This is what happens to the telegraph wires when they hum; and if we put our hand on the telegraph pole we shall feel that the wires vibrate strongly enough to set the whole pole trembling, too. If we think of the way in which our own voices are produced we shall see that the telegraph lines hum in exactly the same way as we hum ourselves. Something stretched, in each case, is made to tremble. When the air is quite still, you will not hear the telegraph lines humming.

WHY DOES THE SMOKE OF A TRAIN GO THE OTHER WAY?

When the smoke leaves the funnel of the engine it is really moving forward, like the engine itself, and at exactly the same rate. If we could imagine that the train was moving onward in *nothing,* then, since we know that moving things always move on in a straight line at the same speed for ever, unless something outside affects them, the smoke would move forward with the train, and would actually pass on in front of it so soon as the driver slowed the train. But the smoke is poured into the ocean of air through which the train is pushing its way. The air tends to stop the train as it tends to stop everything that moves through it, and every engineer knows how important this air-pressure is; but though it retards the train a good deal, it retards the light, hot smoke that is poured into it far more. The question reminds us that the smoke seems to *go* in the opposite direction to the train; but really it simply moves forward so slowly and for such a little distance that, compared with the train, it seems to go the other way.

But if a strong wind is blowing in the same direction as the train—and perhaps this is oftenest seen in the case of the smoke from a ship's funnel—then the smoke is blown forward by the wind far in front of the train or ship. In this case and the last the same principle works, though the results are so different. The principle is that the air affects the smoke more than the train or ship. In one case it holds both back, but it holds the smoke back most; in the other case it blows both forward, but the smoke most.

WHAT GIVES STEAM ITS POWER?

There is an old Scotch proverb that "mony a mickle maks a muckle," which means that many little things put together make much. The power of steam is a case of this, for it can drive great boats through the water and it can tear up the greatest rocks. Yet all its power is due to the coming together of little units of power.

When we speak of steam, we mean water-vapor—water in the form of gas. This gas is formed under pressure, and has power to expand. It is this expansive power that does the work. Afterward the gas becomes cool and condensed, so that we can see it, and that is what we call steam. The power of the gas is due to the tiny little molecules of water of which it is made. Each of these is flying about in all directions trying to get loose, and so striking against the sides of whatever hems it in. The force in one of these molecules is very tiny, for the amount of stuff in the molecules is so small. If you had a hammer smaller than you could see, you could not drive in a nail with it. But as there are billions of these little hammers flying about in the gas, they are able to do all the work that "steam" does.

WHAT MAKES OUR HEARTS BEAT?

It would take a big book to do justice to this question. We know positively that the heart can and does beat in an independent way quite apart from the brain or the rest of the body. If a frog is killed, as, for instance, by cutting its head off instantly—which is so quickly that the frog has no time to feel any pain—then, though the frog is dead, its heart still beats, as we find if we open the body. The heart can be completely cut out of the body, and will lie beating in your hand for a long time. So will the heart of a bird or a rabbit. This proves, of course, that what starts the heart-beat is in the heart, even though we know the brain can make the heart beat faster or slower, or can even stop it.

When we examine the heart of any animal very carefully, we find that it has a large number of nerve cells in it. If we cut a heart to pieces, any part which is cut away from the nerve cells stops beating, but any part which has nerve cells in it will go on beating until, at last, the heart dies from lack of food. But it is very interesting that the heart will go on beating for so long. If we attach tubes to the heart in place of the blood-vessels, and send fluids through it containing common salt and certain other salts which help to nourish it, it will beat for hours or even days—a most wonderful thing. In this way, without causing any pain to any animal—for I am speaking only of a heart by itself, the animal it belonged to having been killed at once—we can study the action of different things on the heart. And it has thus lately been proved that sugar is a valuable heart food, while alcohol is no food to the heart at all.

WHERE DOES THE ELECTRICITY OF THE AURORA BOREALIS COME FROM?

We have lately learned that all hot things give off tiny pieces of atoms, which are now called electrons, and which have powerful electrical properties. This is conspicuously true of the element carbon when it is made hot. Now, the sun is hot, and its outer part contains enormous quantities of carbon; so we may suppose that the aurora borealis is due to electrons from the sun striking the rare gases in the outer part of our atmosphere. But we cannot at all prove our theory unless we call in the help of certain other knowledge.

To begin with, how could the electrons get away from the sun? The sun's gravitation would tend to keep them, and if we are to believe that they are shot out from the sun, we must find something which will shoot them. Here our discovery of light pressure, or radiation pressure, comes to our aid. Without our knowledge of it we should have no right to say that electrons could leave the sun at all.

We cannot suppose that at all times electrons are being hurled in any quantity from the sun, and, indeed, we do not find that the aurora borealis is going on at all times. It is only sometimes, when things happen in the sun, and especially when there are many big sun-spots, that we find splendid auroras and also great disturbance of the magnetic needles on the earth. It has long been known that auroras and sun-spots go together. Now we understand the reason. It is when something or other happens in the sun which makes the sun blaze up and increases the light pressure that electrons can be thrown from the sun in all directions; and some of them, after traveling ninety-three millions of miles at the rate of twenty miles a second, reach the earth.

WHAT WOULD HAPPEN IF GRAVITATION CEASED ON THE EARTH?

If gravitation ceased on the earth, there would be an end of life as we know it. Anything thrown into the air or jumping into the air would illustrate the first law of motion, which is that any moving thing must go on moving at a constant speed in the same straight line for ever unless something stops it. When a ball is thrown in the air, it does not seem to obey this law of motion, for the good reason, that as it rises the earth is pulling upon it, and however strong your throw is, the earth's pull, in the long run, will stop the ball, and finally bring it back again. If the earth's gravitation ceased, the ball would rise out of sight, but even then its motion would be slowly stopped by the resistance of the air. At last the ball would stop rising altogether, *but it would not come back again,* for there would be nothing to make it do so. Even if you threw a ball down on the ground, it would bounce up, and you would never see it again.

At present we do not know the cause of gravitation. It is one of the great secrets. But we may learn it some day, and when we do, we may learn how to control gravitation, or even abolish it at will. This would be utterly different from anything we do now. No balloon does this, but merely provides something which "tells against" gravitation.

CAN WE BREAK OUR HABITS?

Of course we can. But we must know what we mean when we speak of habits. In some ways breathing and eating might be called habits, and we know that we cannot break them, for they really depend upon the very structure and needs of our bodies. But real habits are all things learned, and are not essential, and as they can be learned, they can be unlearned; we can learn the new habit of *not* doing the thing we were in the habit of doing. Almost any ordinary habit can be learned or unlearned in about six weeks.

There are certain special habits, in some ways different from the others, which consist in using certain drugs, such as alcohol, tobacco, opium, and many others. These habits differ because they do not consist merely in the brain learning to do a thing over and over again. These drugs leave behind them in the body poisons which injure it and make us uncomfortable, and then the easiest way in which we can feel better is by taking more of the thing we began with. But these habits also can be completely broken. People always profess great astonishment when "the habits of a lifetime," as they say, are changed; but, as a matter of fact, this happens every day, and is true in some respect or other of almost everybody.

WHY DO THE NORTHERN LIGHTS APPEAR IN THE NORTH?

When the electrons from the sun approach the earth, it seems as if they are conducted along certain lines, instead of just striking it fair and square. We must remember that the earth is a magnet. Now, if we take an ordinary bar magnet and a lot of iron filings, we find that in the space around the magnet there is what is called a magnetic field, and filings or any such things coming within this field will behave in a certain way. They will run toward the two poles of the magnet, and will arrange themselves between those poles in certain regularly curved lines, which are called the lines of force of the magnet, or the magnetic field.

Now, our study of Nature teaches us nothing more certainly than that size, as such, is of no importance. A magnet is a magnet whether it be a bar of iron an inch long or whether it be the earth on which we live; and what is true of one magnet is true of another. Therefore the magnet called the earth must and does behave toward the electrons coming within its field of force just as a child's small magnet will affect the iron filings coming within its field of force.

So we find that when the electrons approach the earth, they are carried toward the poles of the earth, and those which travel through the outer air toward the North Pole, or, rather, toward the North Magnetic Pole, cause what we call the Northern Lights.

Thus we have an explanation, long sought for, of one of the most beautiful facts in Nature, and the special interest of the explanation is not only that it is new, but that it depends upon putting together our newly gained knowledge of light and electricity and magnetism. No wonder, when none of these things were known, that men could not explain the cause of the aurora borealis.

Fire-Making.

By H. L. Jerome. Drawings by Otto Bacher.

Should you find yourself in the wilderness without a match, how could you obtain fire?

THE devices that are in use among uncivilized men for getting fire are interesting. It is a curious fact that the African, in lighting the fire in which to smelt the iron from which he makes his remarkable steel weapons, uses neither stone nor metal in obtaining the first spark. It is interesting to observe the fire-making tools that have been used. They may be divided by the sort of motion required into four classes. Indians, Australians, Eskimos, Hindus, and others use the whirling or drilling motion. Malays, Burmese, and others use a sawing movement. Polynesians, Papuans, and others use a plowing motion, while the custom of obtaining fire by striking a light seems now as common among barbarous as civilized men. In nearly all tribes several methods are used, according to circumstances and the means at hand. A very fine collection of fire-making implements may be seen in the National Museum in the Smithsonian Institution at Washington.* Nearly every method is represented there.

The simplest and probably the oldest and most widely used device is called the two-stick apparatus. It has been used everywhere and at all times. It consists of a rough plank or large stick, which rests on the ground, as a hearth, and a smooth, round stick, from one and a half to two feet long, which we will call the drill. In the gradual improvement of this simple but necessary tool the different tribes show their mental development—their ingenuity or power of thinking.

The wood chosen for the hearth is dry, worm-riddled pieces of the juniper, white maple, or cedar. Drills are also chosen of dry inflammable wood. Many tribes prefer the starchy stem of some flowering plant.

The hearth has one or more—usually many—holes or shallow sockets drilled in its upper face, and narrow slots leading from these sockets or fire-holes to the tinder beneath. The tinder is made of shredded bark, or fungus,

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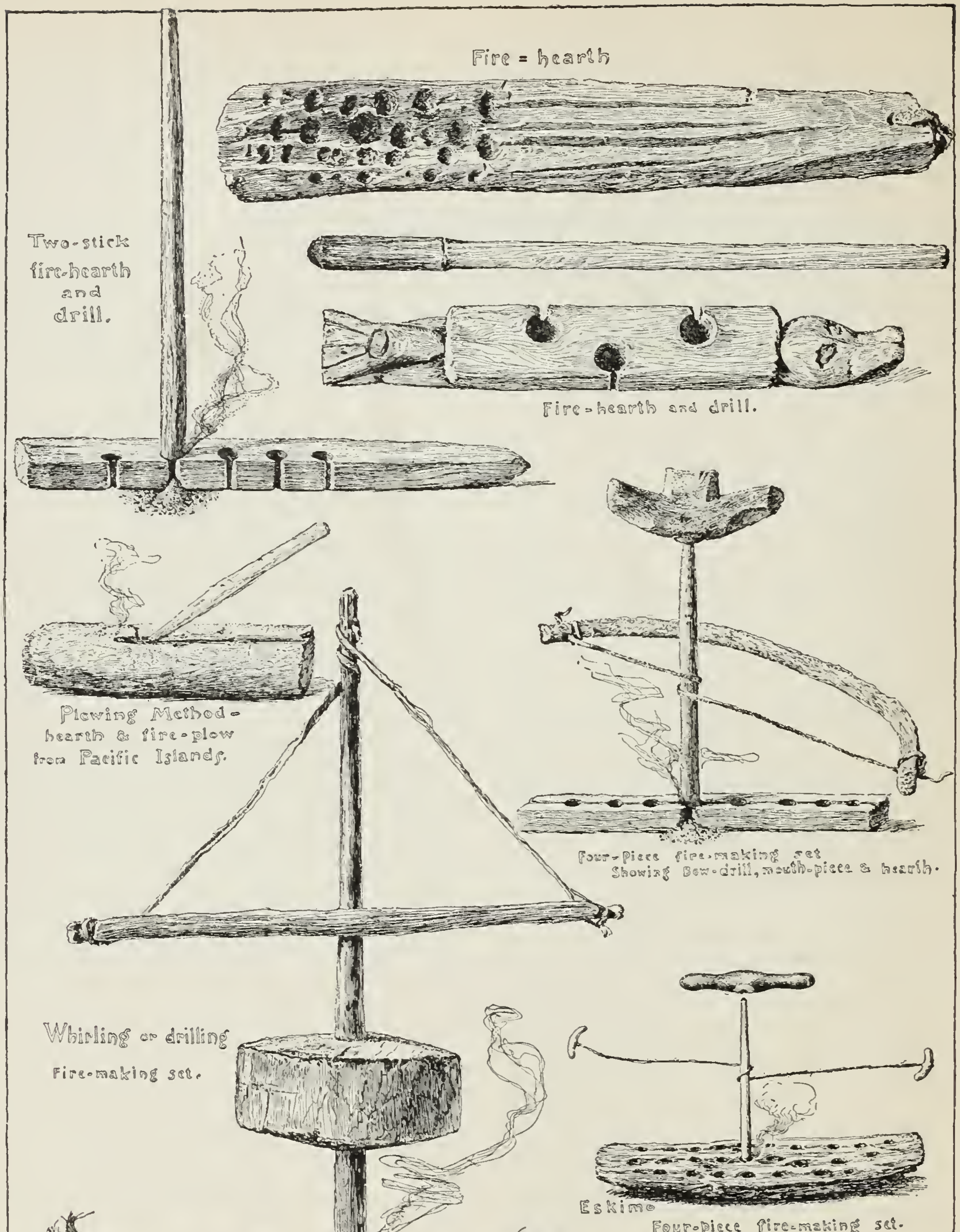
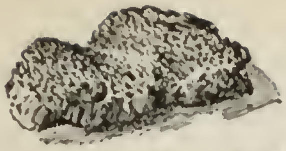
* The illustrations of fire-making tools for this article were made from the real objects in the Museum of Natural History, New York.


Fire = hearth
Two-stick fire-hearth and drill.
Fire-hearth and drill.
Plowing Method - hearth & fire-plow from Pacific Islands.
Four-piece fire-making set Showing Bow-drill, mouth-piece & hearth.
Whirling or drilling Fire-making set.
Eskimo Four-piece fire-making set.
Otto H. Bacher 95



Soft, corky wood.

which will catch fire quickly and burn slowly, like a slow-match.

An Indian kneels with one knee on each end of the hearth, which is of a convenient length, and placing an end of the fire-stick upright in one of the sockets, or fire-holes, twirls it rapidly between his open palms by rubbing them back and forth past each other almost to the finger-tips. At the same time he presses the drill firmly into the fire-hole, letting his hands move down the drill until they nearly reach the bottom, when they are brought back to the top with a quick, deft motion, and move swiftly down again.

Soon you will see that the wood is being ground off the end of the fire-stick in a fine powder that collects in the narrow slot leading from the fire-hole to the tinder beneath. As the amount of powder increases, it grows darker and darker, until it is almost black. You will notice the odor of burning wood, and after the stick has been twirled from fifteen to forty-five seconds, a little curl of queer-colored smoke will begin to arise. Combustion has begun. The Indian will then tap his wooden hearth, and the smoking pellet will drop out of the slot to the tinder below, where it can easily be blown into a blaze.

It is necessary to keep the fine, friction-heated dust in a close heap if fire is to be generated from wooden tools.

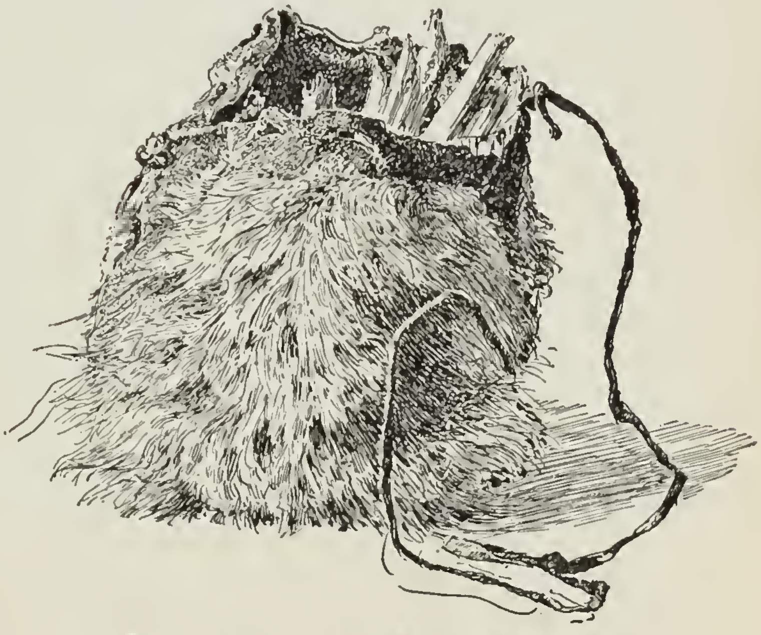
The Quinaielt Indians of the far Northwest used a drill which tapers at each end. This makes the downward pressure more firm, and does not allow the hands to slip down too rapidly. They used a slow-match of frayed and braided cedar bark, which could be lighted at one end and carried for many days under the blanket if carefully protected from wind and rain. The slots in their hearth are broader, which allows the dust to collect in larger quantities before dropping below.

Some tribes make their fire-making tools more inflammable and more easily ground away into combustible powder by charring the drill in the fire. Sand is often used to increase the friction. This method of making fire was sufficient for its time, for it was seldom necessary to make a new fire except as a religious ceremony. The art of fire preservation was at its height. Mr. James Mooney reports that "the Cherokees kept fire buried in the mounds upon which the council-houses were built, so that if the house was destroyed by enemies the fire would remain for a year or so."

Some tribes use a hearth rounded and tapering at each end. The fire-slot widens toward the bottom, so that the pellet in dropping may have draft. The hearth is made of soft wood, while the fire-stick is made of the hardest wood obtainable, and is pointed with resin.

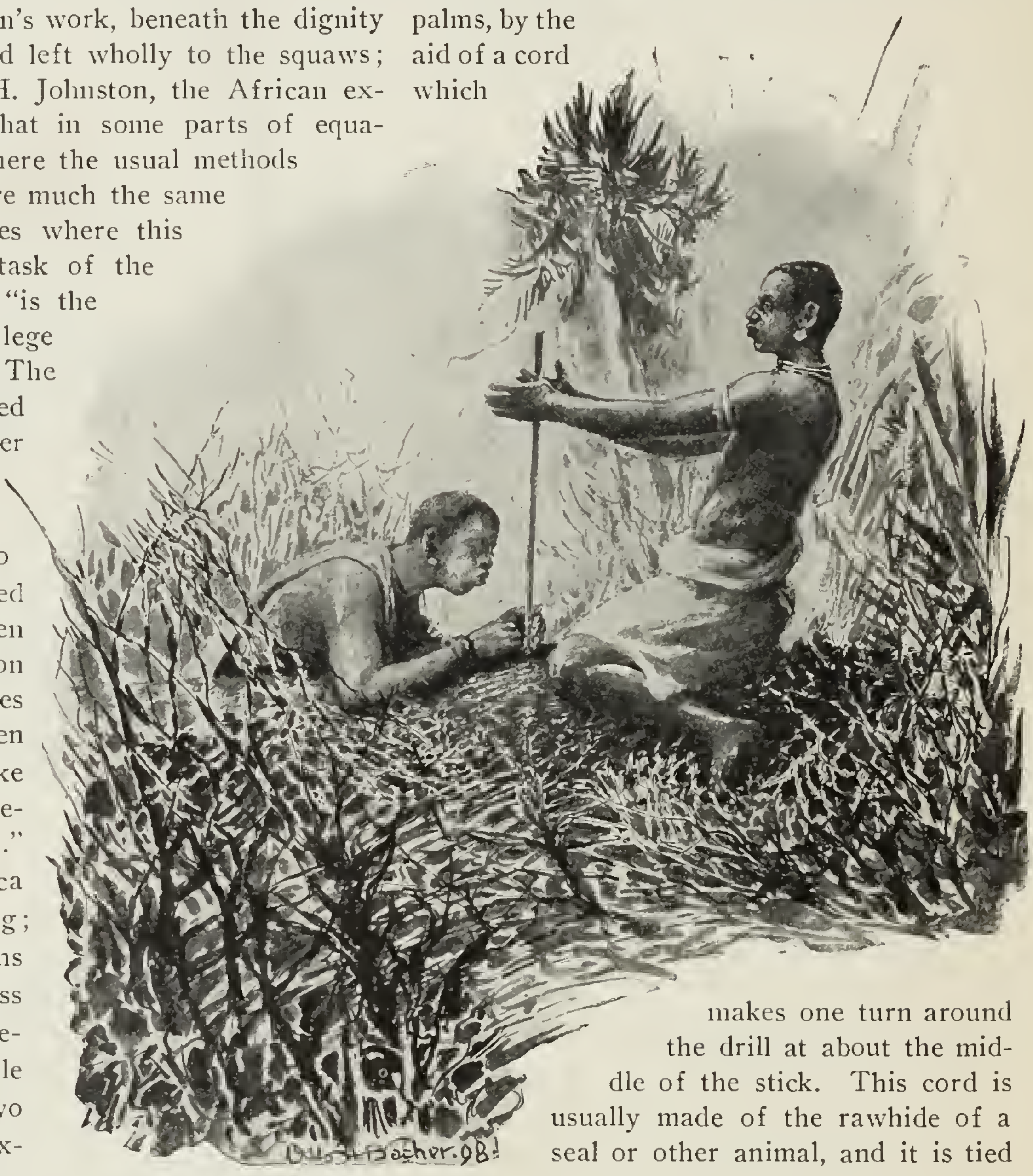
The Hupa Indians of California use a hearth-block of hard wood, and a drill of soft wood which has been charred on the grinding end. It is much easier to start a fire with a fire-set which has been for some time in use than with a new one; and therefore the set is usually in the care of the most skilful fire-maker, who wraps the parts carefully with long, narrow strips of buckskin, and keeps them beneath his blanket where they will not become damp.

An Indian takes great pride in being a quick fire-maker. Captain J. G. Bourke, U. S. A., reports having seen the Apaches secure fire with this simple apparatus in eight seconds. Under the most favorable conditions the Apaches claim to be able to make fire with a series of motions that occupy exactly two seconds. If this can be done, the Apache is the most skilful fire-maker on record. One can scarcely strike a match in less time.



Deer-skin tinder-bag.

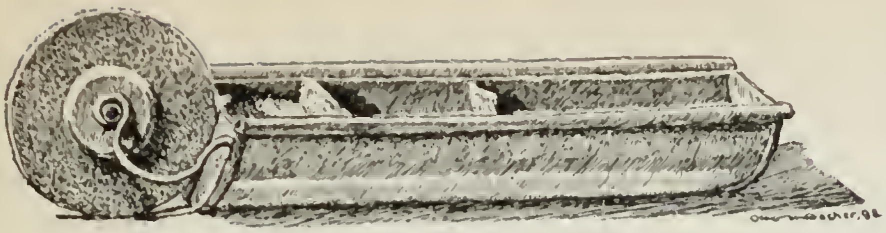
Many tribes can produce fire in less than forty-five seconds; and nearly all tribes resort to many devices, using flint and steel at one time, the fire-drill at another, or, if unable to obtain either of these, they can produce a spark by rubbing one dry branch up and down another. In some tribes the fire-making is considered women's work, beneath the dignity of a warrior, and left wholly to the squaws; but Sir Harry H. Johnston, the African explorer, reports that in some parts of equatorial Africa, where the usual methods of fire-making are much the same as in those tribes where this is the peculiar task of the women, the art "is the exclusive privilege of the men. The secret is handed down from father to son, and it is never, under any conditions (or so they say), revealed to women." When asked the reason of this, the natives replied: "If women knew how to make fire they would become our masters." In southern Africa the hearth is a log; and the Africans are so much less expert with the fire-drill that the whole strength of two men is often exhausted in producing fire. One man whirls the stick until both hands have descended almost to the lower end, then the other man begins at the top and continues the movement while his companion waits to relieve him in the same way. The second man also keeps the dust close to the point of the whirling stick, and gently blows it into a flame at the proper time. The African's clumsiness in fire-making, and the fact, before referred to, that he does not use the products of his forge to strike a fire for its lighting, is one of the interesting and curious anomalies of savage life.



AFRICANS USING THEIR FIRE-MAKING APPARATUS.

The Eskimo has added a curious feature to his fire-drill. The drill and hearth are in most ways very similar to those already described, but he whirls the drill, instead of between his palms, by the aid of a cord which makes one turn around the drill at about the middle of the stick. This cord is usually made of the rawhide of a seal or other animal, and it is tied at each end to a handle cut from a hollow bone, or fashioned out of a bear's tooth or a bit of wood. In order to keep the stick in place in the shallow fire-hole it must be held at the top; therefore there is a fourth piece of apparatus necessary. This fourth piece is usually a flat, straight bit of bone or ivory, in which a socket is made to admit the upper end of the drill, as will be explained.

When one man is to make the fire this top-

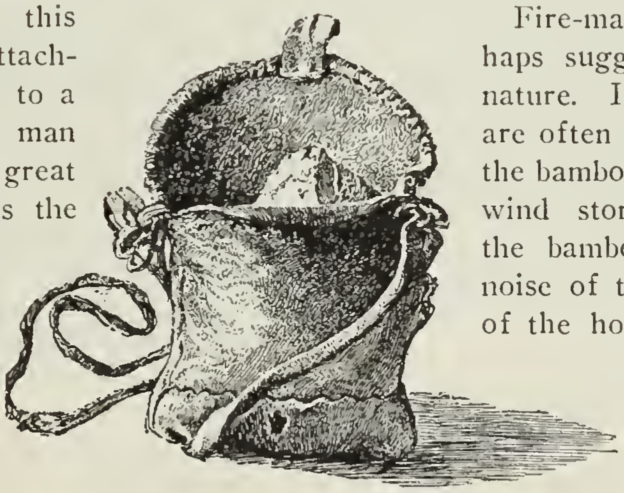


Wheel tinder-box.

piece is held between the teeth. A civilized man can scarcely endure the jar on the jaws and head produced by whirling a stick thus steadied by a block held between the teeth. Among the Eskimos it is seldom necessary for a man to make fire alone. It is a matter in which all have an interest, and two men usually make it together, each pressing the top-piece with one hand and each holding one end of the whirling cord with the other.

The top-piece is sometimes merely a block of wood, ivory, or bone, but is more often elaborately carved to resemble a seal, bear, whale, or walrus. The upper part is raised to form a good grip for the teeth, and many of the specimens in our National Museum are chewed in a way that shows the power of the Eskimo jaw. When the piece is intended for an assistant to hold in his hand, it is larger and has no teeth-grip. In the under part of the top-piece there is a cup-shaped hollow set with some stone having antifriction qualities. These stones seem to be chosen for their beauty. They are mottled, striped, or beautifully ringed. Against this inlaid stone in the hollow the top of the fire-drill rests and revolves easily.

An improvement on this four-part fire-drill is the attaching of the whirling cord to a bow. This enables one man to whirl the stick with great rapidity, and if he holds the top-piece between his teeth or against his breast (when it is made broad and of convenient shape), he can start a fire or drill a hole easily alone. The bow is evidently an improvement on the handled cord, and is an ingenious idea. These bows cannot easily be carved, as are the top-pieces; but, true to his passion for elaborate decoration, the Eskimo makes the bow of the gracefully curved ivory tusks of the walrus, and, after working them down, covers the surface with the most lively and graphic engravings of the reindeer, whales, seals, and bears he has killed, or with a picture-history of his hunting and fishing expeditions.

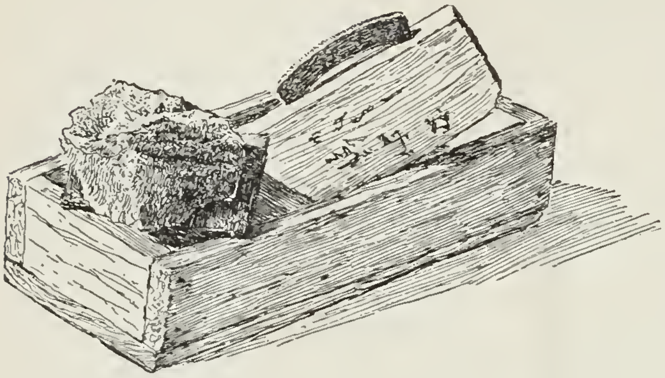


Leather fire-bag.

The hearth is especially adapted to the snowy home of the Eskimo. Should the heated pellets of powder fall through the slot to the ice-covered ground they would never ignite. The Eskimo, therefore, cuts steps in his hearth so that the pellet will fall to the lower step. Some hearths have a central hole to which the slots from the other fire-holes lead. At times the central-hole hearth and the slot-and-step hearth are both used in the same tribe. The Eskimos also have "fire-bags" made of sealskin, and often embroidered with excellent needlework, in which to carry the drill and the tinder so that they may be kept very dry. The down of the arctic willow is used as tinder. The use of these sets for fire-making is probably secondary. They were undoubtedly used primarily for boring holes in wood and bone. When used for boring, the drill is tipped with flint or bone. The mouthpiece usually has a hole in one end through which a cord can be tied to secure it to the other pieces, so that in moving it may not be lost in the snow.

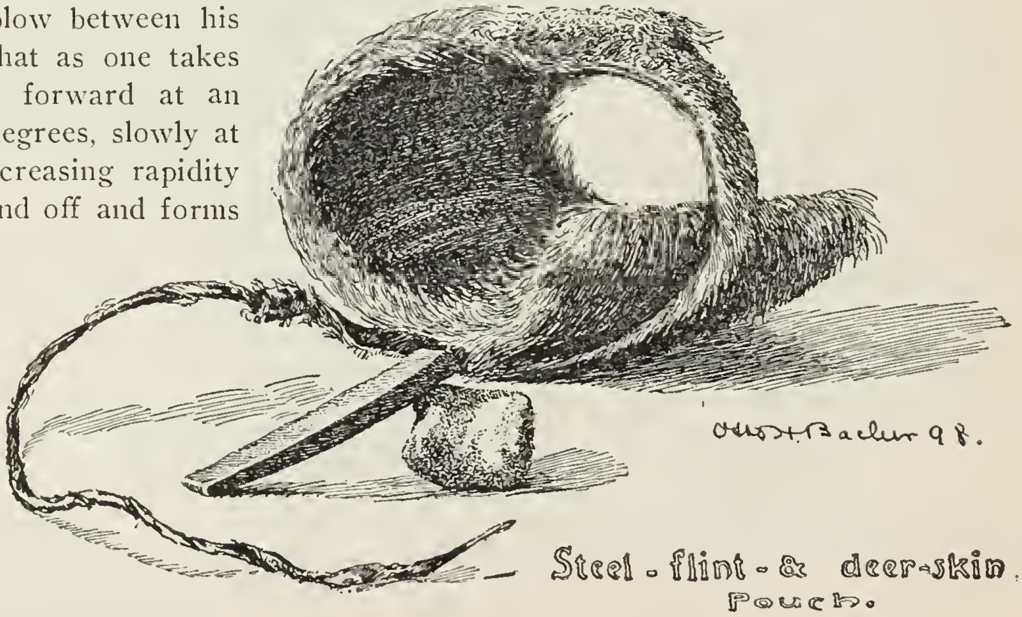
Fire-making by sawing was perhaps suggested to the Malays by nature. It is said that jungle fires are often started by the rubbing of the bamboo stocks together in high-wind storms. "The creaking of the bamboo is indescribable; the noise of the rasping and grinding of the horny stems is almost unendurable" during these storms, say travelers.

However the method may have been suggested to them, it is a very simple one. A piece of bamboo having a sharp edge is rubbed across a rounded piece in which a notch has been cut. The Malay saws across until the hollow convex piece is pierced. The heated particles fall below and ignite. Some Malays "have improved on this by striking a piece of china, tinder being held with it, against the outside of a piece of bamboo, the silicious coating of the latter yielding a spark, like flint"; but the sawing knife is more commonly used. Sand is sometimes added to increase the friction. In some places, when the particles fall they are gathered in a dry leaf and swung around the head until the leaf blazes.



Japanese steel, mounted in wood, flint, & tinder-box.

The plowing method seems to have sprung wholly from the Pacific Islanders. It is closely connected with the sawing method. A soft, corky bit of wood is picked up near by, and a small, pointed stick of hard wood is found. Kneeling on the hearth or soft stick, the man holds the pencil-like plow between his clasped hands, somewhat as one takes a pen, and forces it forward at an angle of about forty degrees, slowly at first and then with increasing rapidity until the wood is ground off and forms in a small heap at the end of the groove he has so made. The groove is about six inches long. Mr. Darwin found it difficult to make fire in this way, but at last succeeded. The Samoan can get fire in forty seconds, and some can make the wood burst into flame by this method.


Otto H. Bacher 98.

Steel - flint - & deer-skin pouch.

The fourth method of obtaining fire—that of "striking" a light—is one familiar, in a degree, to all. Before steel was obtainable, flint and pyrites were used. Eskimos of the Mackenzie River district use a fire-set composed of a tinder-pocket, which contains tinder made of down from the willow catkins mixed with charcoal, or soaked in gunpowder and water, a rough bar of flint, and a half-sphere of pyrites, evidently a round stone broken in two for greater convenience.

The tinder-bag is made of reindeer skin. A little bag hanging from the larger one contains tinder to use in case that in the larger one becomes accidentally useless; but the little bag also acts as a toggle. It is passed under the belt when the tinder-bag is carried by the squaw, much as our women wear their chatelaine-bags. The cover of the bag is an oblong pad stuffed with deer hair. This pad is held on the forefinger under the pyrites to protect the hand when a spark is being struck off into the tinder in the bag.

With the Iron Age came the use of the flint and steel, and the most ancient specimens of these fire-making tools are so nearly like those found in many an old garret to-day that description seems unnecessary. Various devices were invented to improve the common strike-a-light. One of these was the wheel tinder-box. The wheel was spun by sharply pulling a cord which had been wound around its projecting axle, much as one spins a top. The flint was pressed against the whirling wheel, and a shower of sparks fell into the tinder within the box. The pocket strike-a-light is still used by the peasants of France for lighting their pipes.

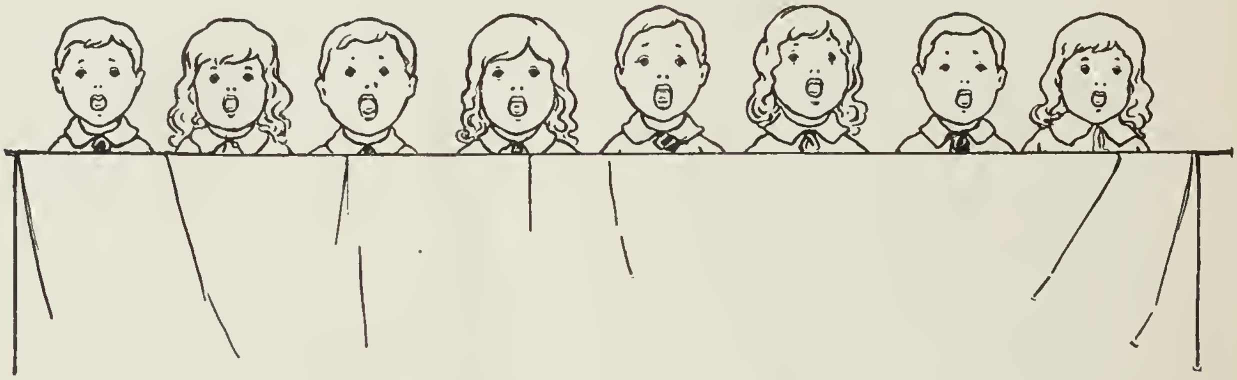
The Chinese strike-a-lights show a very ingenious way of combining the steel with a pouch in which to carry the flint and tinder. In Tibet the pouches are often elaborately trimmed with incrusted silver set with costly jewels.

The Ainos of Japan have a particularly convenient fire-set. The shoe-shaped steel is fastened with a piece of sinew to the cork of a wooden bottle containing the soft charcoal used as tinder. Besides the small piece of flint, there is also a curious fire-stick which burns like a slow-match for a long time, and a pouch of twined and woven rush in which to keep these articles. "The Aino takes out the cork with the steel attached, and stirs up the tinder with the sharp point. He then holds up the flint in his hand over the box, and strikes a spark down into it. He transfers the coal to his pipe, or material for fire, or fire-stick, with the point of the steel."

The Japanese still use flint and steel. Their tinder-boxes have two compartments. The smaller one is for the tinder and has a damper. The larger one is for the flint and steel. They mount the steel in wood. A picture on the preceding page shows that until matches were invented the most convenient fire-making tools in the world were those used in Japan.

Our North American Indians were slow to acknowledge civilized arts and methods as superior to their own; but fire-making with flint and steel appealed to them at once, and was promptly adopted. Buckskin pouches were made in which to carry the flint and steel, and hung from the belt beside the tomahawk. They have many curious beliefs concerning fire and its origin. The Alaskan Indians will tell you that "Yetl," the Great Raven, who created man and gave him all blessings, after obtaining light and fresh water, stole a burning brand from a fire island (volcano) in the sea, and started back to earth holding it in his beak. But the journey was so long that the brand burned shorter and shorter. Swiftly and more swiftly Yetl plied his magic wings; but the brand burned his bill, and then dropped to the ground and scattered in all directions. And because the divine fire, dropped from Yetl's beak, entered into every rock and every dry bit of wood lying on the surface of the earth, they say one can always call fire out of the rocks by striking them with steel, or out of wood by rubbing it with other wood.

This is the Alaskan explanation of the mystery known to us as fire-making.



A TOPSYTURVY CONCERT

BY GEORGE BRADFORD BARTLETT

THIS is one of the funniest entertainments ever seen, and one of the easiest to prepare.

It needs only a screen or a curtain stretched across any room.

The height of the curtain may be determined by the size of the children who sing in the concert, for they stand in a row behind the screen or curtain.

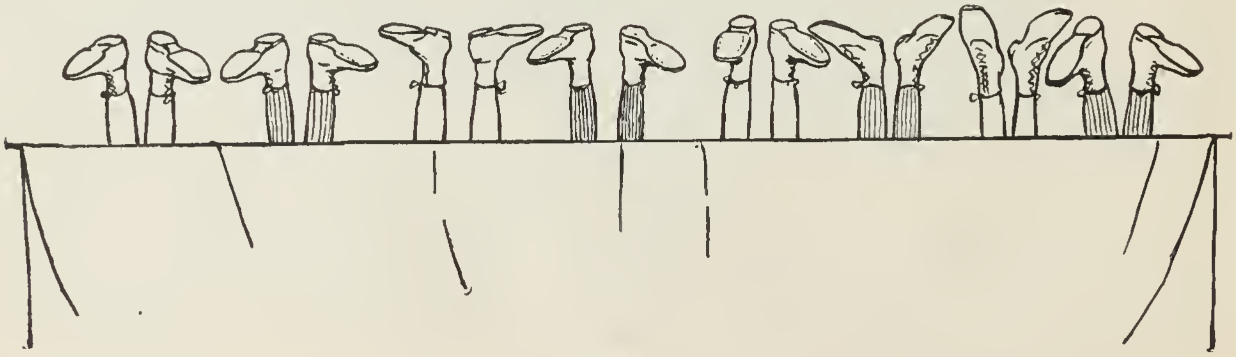
It is well to have these singers nearly of the same size, as the screen or curtain should conceal all of their bodies except the head and neck.

The only preparation required is that the arms and hands of each should be covered with stockings, and that shoes be worn upon each hand with the soles of the shoes pointed forward, so that the toes will be turned toward the spectators, who are seated in front of the curtain at a little distance. At the conclusion of each verse the singers stoop down all together and very quickly, and each, lowering the head, elevates the arms above the curtain.

The effect thus produced is that all the singers' seem to be standing on their heads.

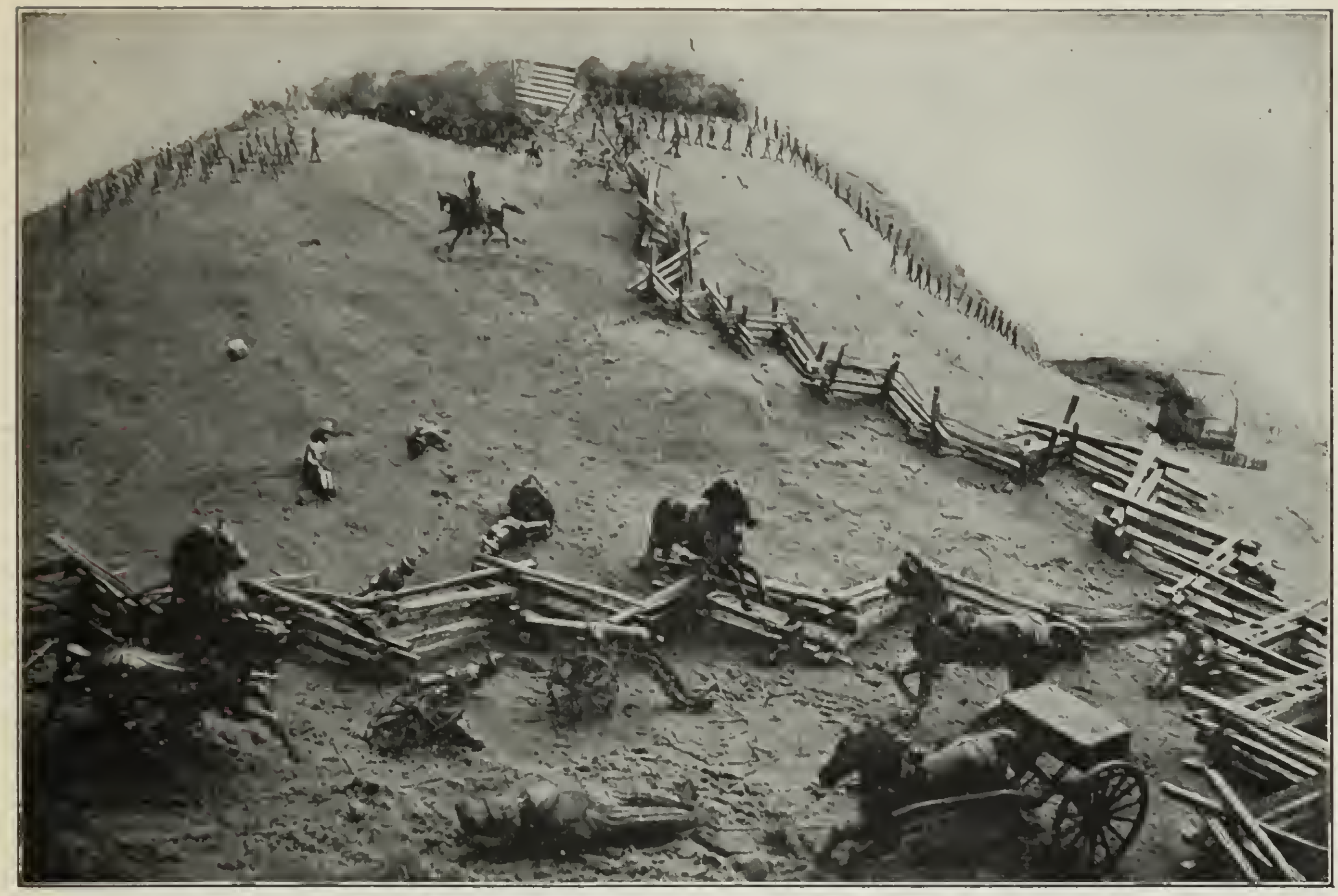
They keep time with their feet (or rather hands) to the music of the song, and the sudden changes, when done simultaneously, will never fail to amuse.

The idea of this unique performance probably originated in the fertile brain of a Frenchman; but it has been adapted for the use of children, and will prove an enjoyable addition to the holiday merrymakings.



A SAND-PILE

BY HARRY M. LAY



A SCENE FROM "THE BATTLE OF 'BAWLED HILL.'"

(The sand-pile is about two feet high, the fence in the distance is of matches, and, approaching the foreground, of slightly larger bits of wood. "The woods" are curled hair; the rider is two inches high. Figures in the foreground are toys of the usual size.)

The attractive display of ingeniously contrived toys which fill the shop-windows about the holidays are interesting to every "grown-up," and altogether fascinating to children.

I doubt, however, if a whole shopful of fine toys contains so inexhaustible a resource for amusement and imagination as a pile of clean moist sand. My little son and I have convinced ourselves of this, for we have had "no end of fun" in our sand-pile in the yard.

We built viaducts, tunnels, and forts, and let our imaginations have free rein. We lived in a delightful little world all our own. One day we took his little iron patrol-wagon and horses, his brass cannon, and his company of lead soldiers out to the sand-pile. That suggested at once a battle scene, and we began to lay out a field of action.

Uncle Arthur used to tell us funny stories about a great battle he was supposed to have been in, once upon a time, and we decided to illustrate his wonderful experiences in that famous battle of "Bawled Hill," with the "Army of the Kankakee."

We heaped the sand into a pile about two feet high to represent the "hill," and packed it smooth so as to make it look a great way to the top of it. To help this impression we built a tiny rail fence of matches along the brow of the hill, and placed the little lead soldiers about near the fence to represent the advance-guard of the enemy. Next we built a rail fence of larger sticks toward the front of the scene. Here we placed the patrol-wagon and horses with their little iron driver to look as if fleeing to a place of greater safety, and the little brass cannon overturned as though by a well-aimed shot from the distant enemy. The hose-cart horse did service as a dead artillery animal. The rag brownie was made to represent Uncle Arthur, and set astride a detached fire-engine horse in full flight, and you can imagine how they looked!

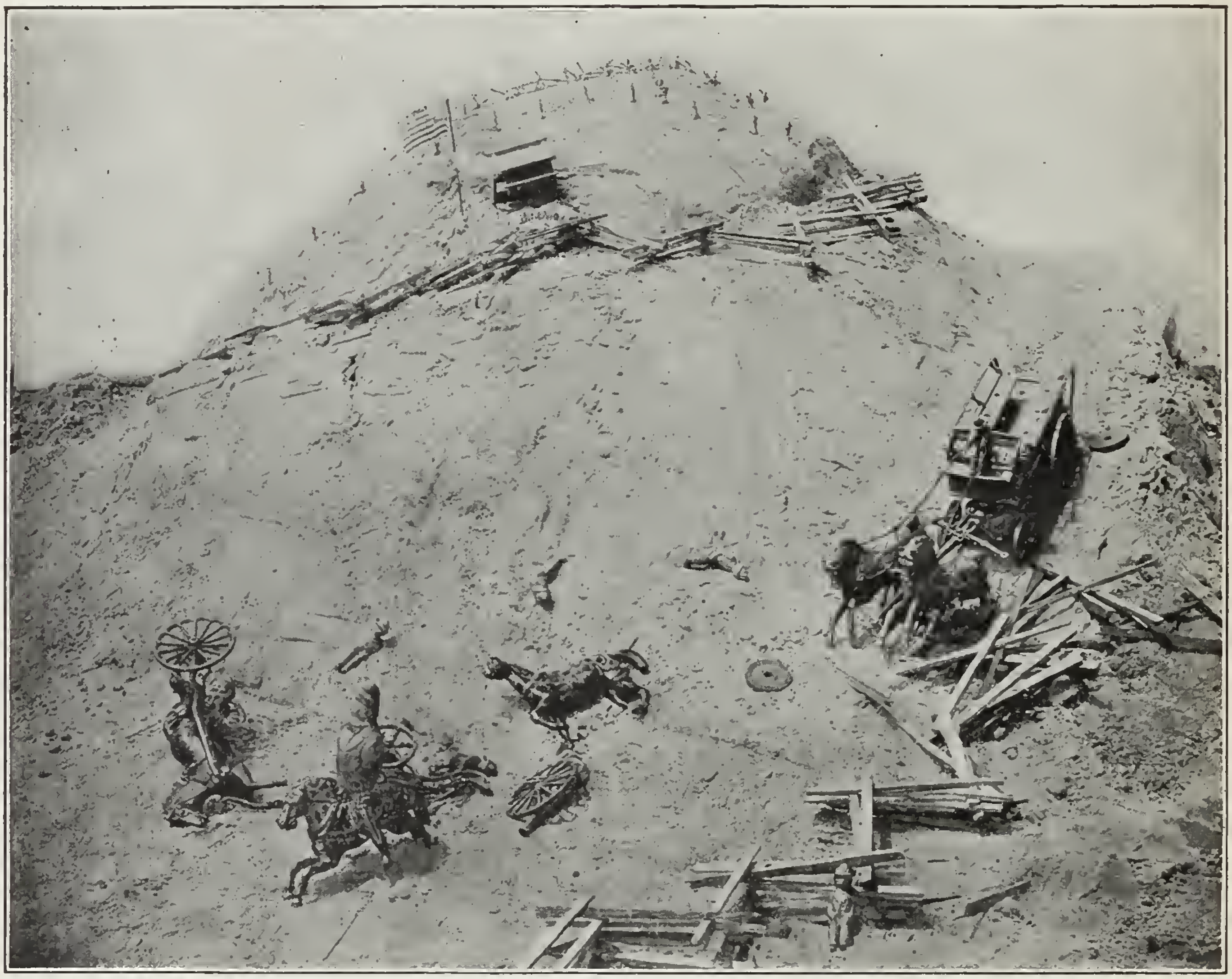
The effect was so amusing that I determined to make a picture of it with my camera. When the photograph was finished we were all astonished and delighted with the result.

The little hill of sand looked as if it were a quarter of a mile high.

Here, then, was a fertile field for the play of our imaginations. It promised amusement and instruction for a long time to come, and we were at once filled with a great desire to make other pictures. Then we found we had no soldiers, or similar figures, of the proper size for the foreground and middle distance, and to buy them all would be too expensive. So we decided that we could make better ones ourselves of modeling-clay. In making these we found another source of amusement and real instruction we had not expected; and we succeeded so well with the clay that it was almost as much pleasure to model the little clay figures as to set them up in the scenes afterward.

Having decided upon the kind of figure wanted for any particular part of a picture, we first constructed a wire skeleton of fine, soft stovepipe wire, and bent the arms and legs into the proper positions. That helped to give the correct action, and held the clay together.

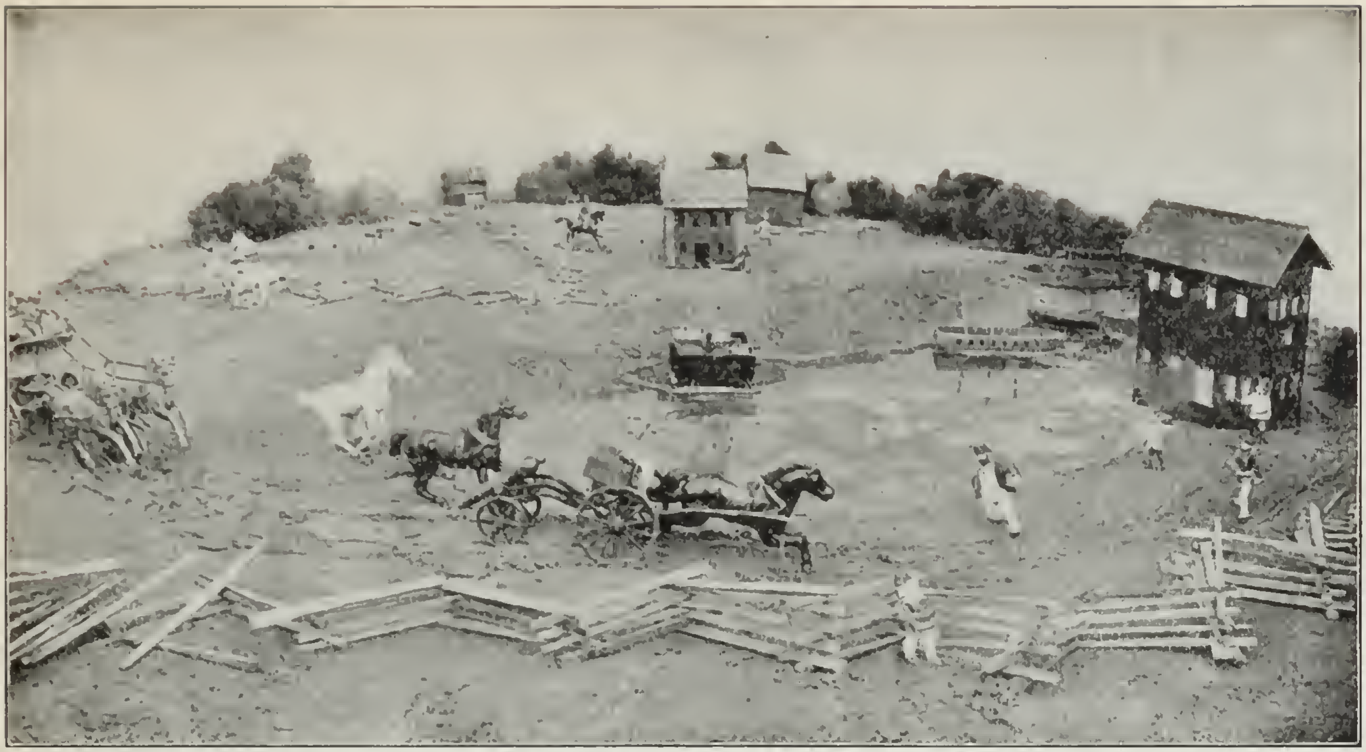
Very few tools were necessary. Our fingers were the best tools we could find. In addition to them we had only a thin-bladed palette-knife, a wooden knife, a soft pencil, a brush, and a cup of water. The clay was very nice to handle, as it did not stick to the fingers as common clay does. While the clay figures we made were not works of art, they had at least the necessary appearance of life and action, and their effect was very funny when they were placed in effective positions. The smallest ones were always put farthest back, while the larger ones were put nearer the front according to their comparative sizes. The effect of this was very lifelike, and gave an impression of much greater distances.



ANOTHER SCENE FROM "THE BATTLE OF 'BAWLED HILL.'"

(A pile of sand about two feet high, fences made of matches and small sticks, iron toys, and little lead soldiers. The house is a toothpick box.)

When the little clay figures had dried hard they were colored with water-color paints. It

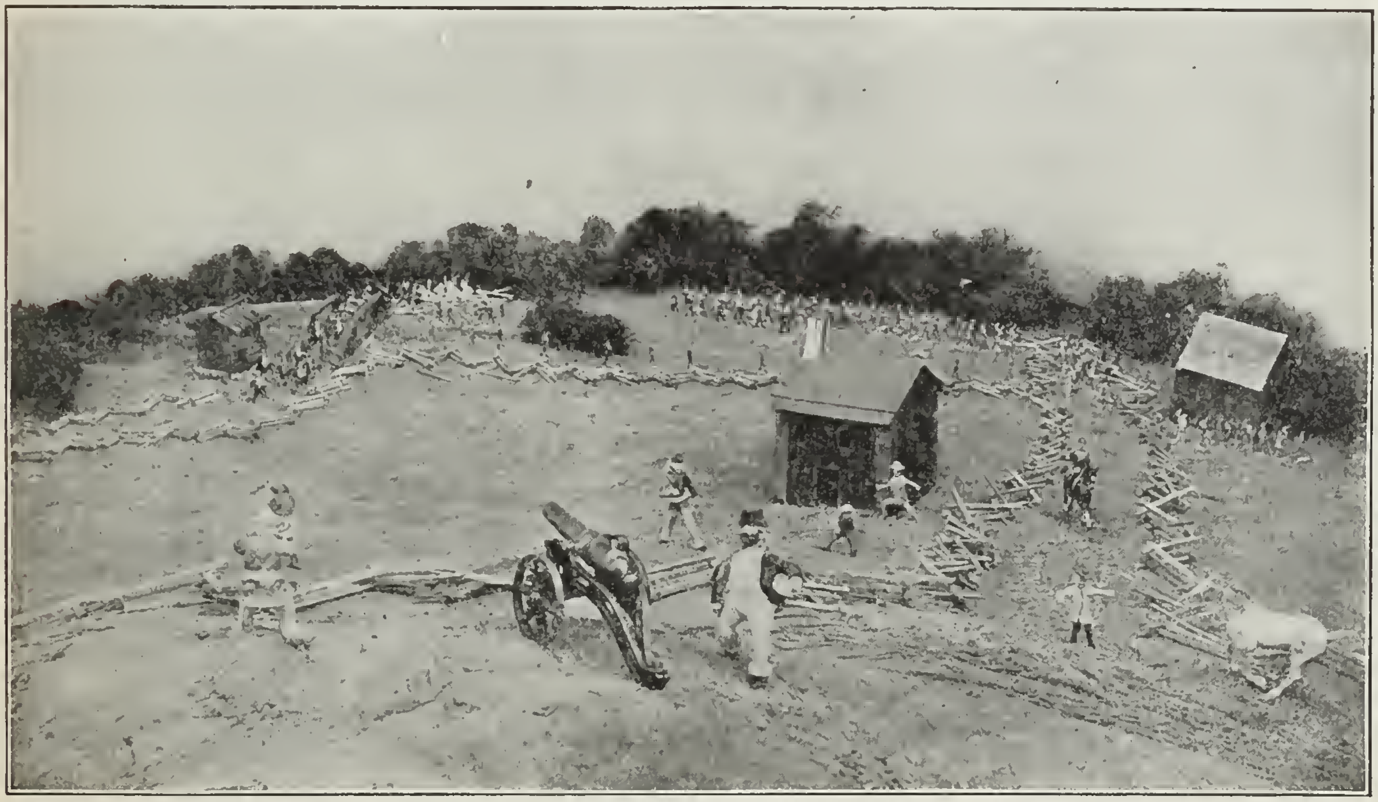


THE "ARMY OF THE KANKAKEE" IN FULL RETREAT.

would have been better if we had used some other color than blue, as that color always shows white in a photograph.

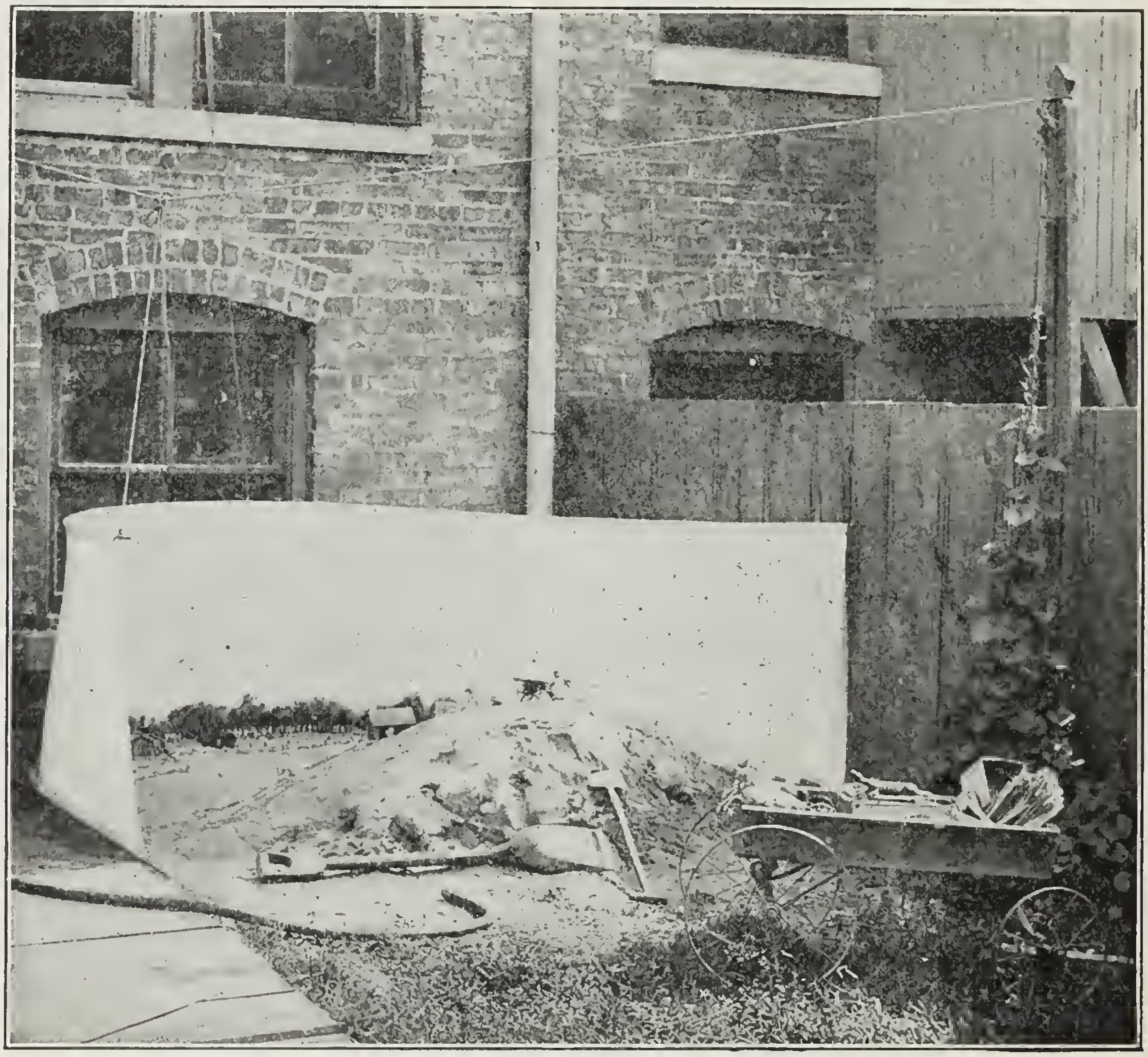
Next we set to making fences, houses, and barns. Post-and-rail fences were in sections from six inches to a foot in length, and from two to three inches high, and were made of pasteboard and wood. Particular care should be taken about the sections of fence intended to go near the roadway at the back part of the scene and to give the impression of great distance. Each little stick is whittled narrower toward one end, and the sticks representing the posts are put nearer together as the narrow end is reached, since they would really seem so.

There is nothing which is so deceptive in effect



"OUR BRAVE SOLDIERS (MOSTLY GENERALS) WERE ALWAYS CONFRONTED BY A GREAT FORCE OF THE ENEMY."

as this fence, and if the other figures are in exact proportion the illusion will be perfect. These sections are no longer than those in the foreground, and they are very easy to make—just a little fish-glue will hold the pieces together very well, and cigar-boxes, berry-boxes, or even pieces of heavy pasteboard are always easy to get. From the same materials we made the houses and barns, afterward painting the doors and windows upon them.



VIEW SHOWING THE "SKY," AND THE BUILDING OF A BATTLE-FIELD.

Now we found that we must have something to represent the sky—for who ever saw an outdoor picture without a sky? This was perplexing, because the sheet to be used for that purpose must not show the slightest wrinkle or anything that would betray its real character.

My wife hemmed some muslin eighteen feet long, and a blacksmith furnished some curved iron rods which we drew through the hems and thus suspended the sheet, as can best be seen in the picture.

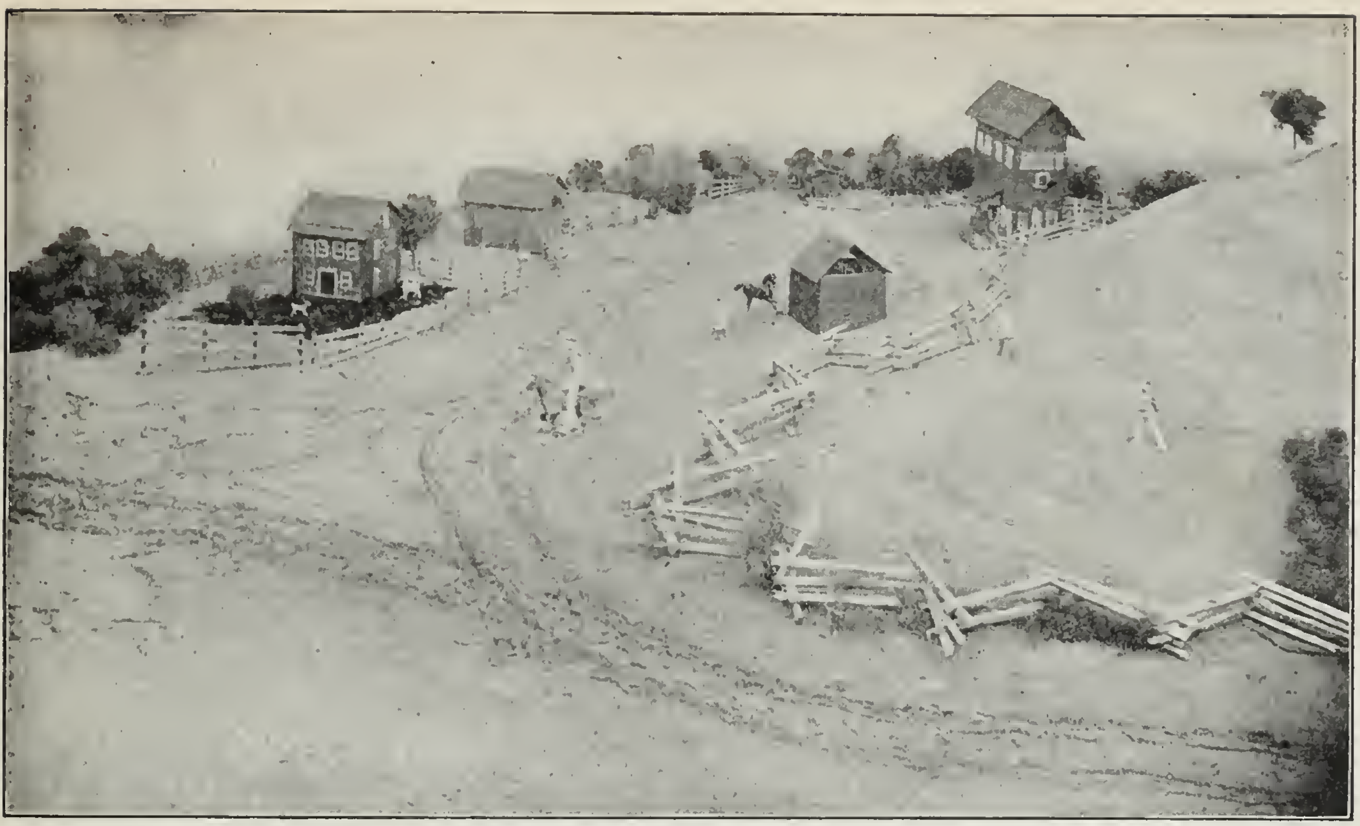
To get the wrinkles out, the sheet was thoroughly wetted, and, as it dried, it stretched itself until every wrinkle disappeared.

Before placing in the sand the figures for a picture we carefully smoothed out every little lump or imprint, and packed the surface down until all detail was wiped out, because to look far away nothing should seem distinct.

Then we were ready to construct our pictures. We built up a hill, and, commencing at the back, we placed some curled hair in loose bunches to represent woods.

Next came the rail fence on the sides of the road leading down the hill. Commencing at the top we began laying it with matches, and, as it drew nearer, larger sticks, followed by still larger ones, were used until the fence reached the foreground. The placing of the houses and other buildings depends on their sizes.

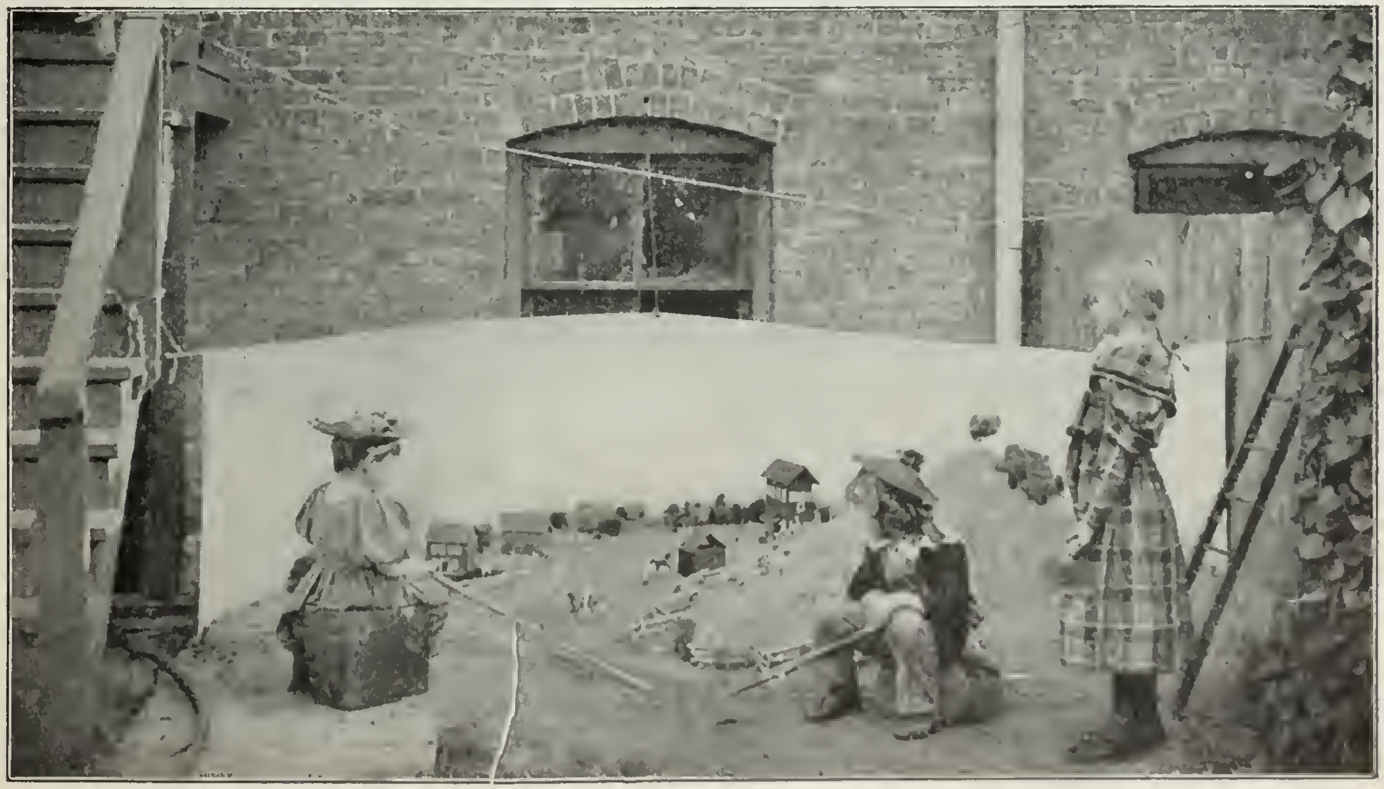
When all these were in proper place we were ready for the figures. To make it more interesting we imagined that the enemy's cavalry was just coming over the top of the hill in pursuit of



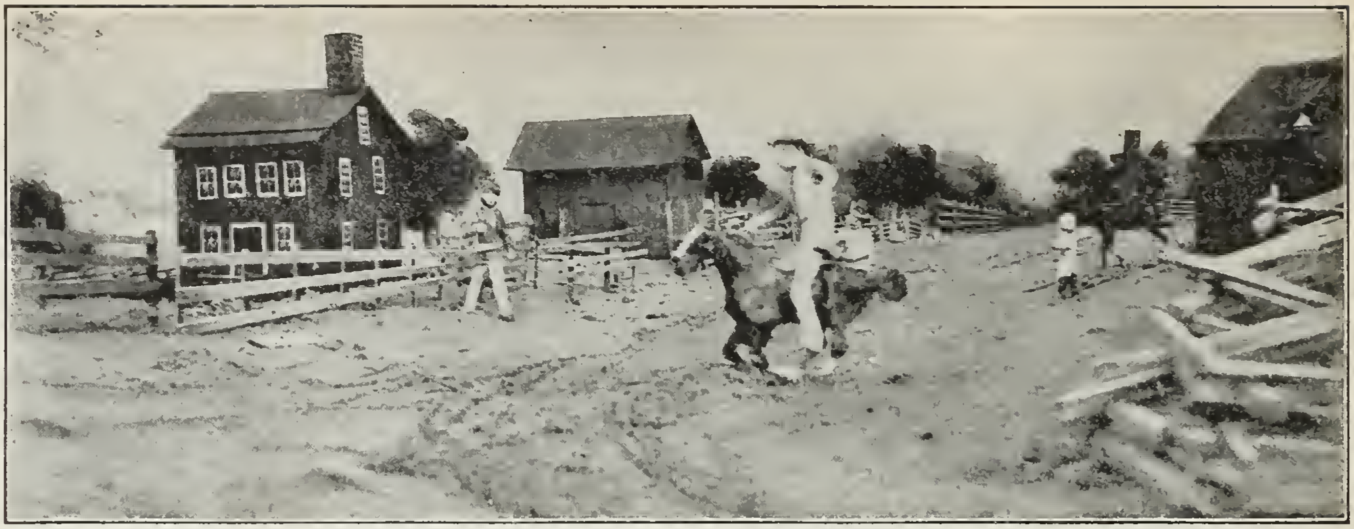
THE COUNTRY CROSS-ROADS.
(The "mill" is the building on the extreme right.)

the routed "Army of the Kankakee" that Uncle Arthur told about. The "army" can be seen tearing down the hill in a wild flight—a sort of a Bull Run panic. The soldier riding backward down the hill is "General Calamity," who has vowed never to turn his back to the enemy. The iron patrol-wagon and some of our fire-department toys fitted into such a scene very well, as representing both the artillery and the baggage-wagons.

A correct idea of the effect of distance obtained by making the fences run to a point toward



PHOTOGRAPH SHOWING ACTUAL SIZE OF THE OBJECTS IN THE SAND-PILE SCENE "THE COUNTRY CROSS-ROADS."



ANOTHER VIEW OF "THE COUNTRY CROSS-ROADS."
(Taken with the camera on a level with the horseman in the foreground.)

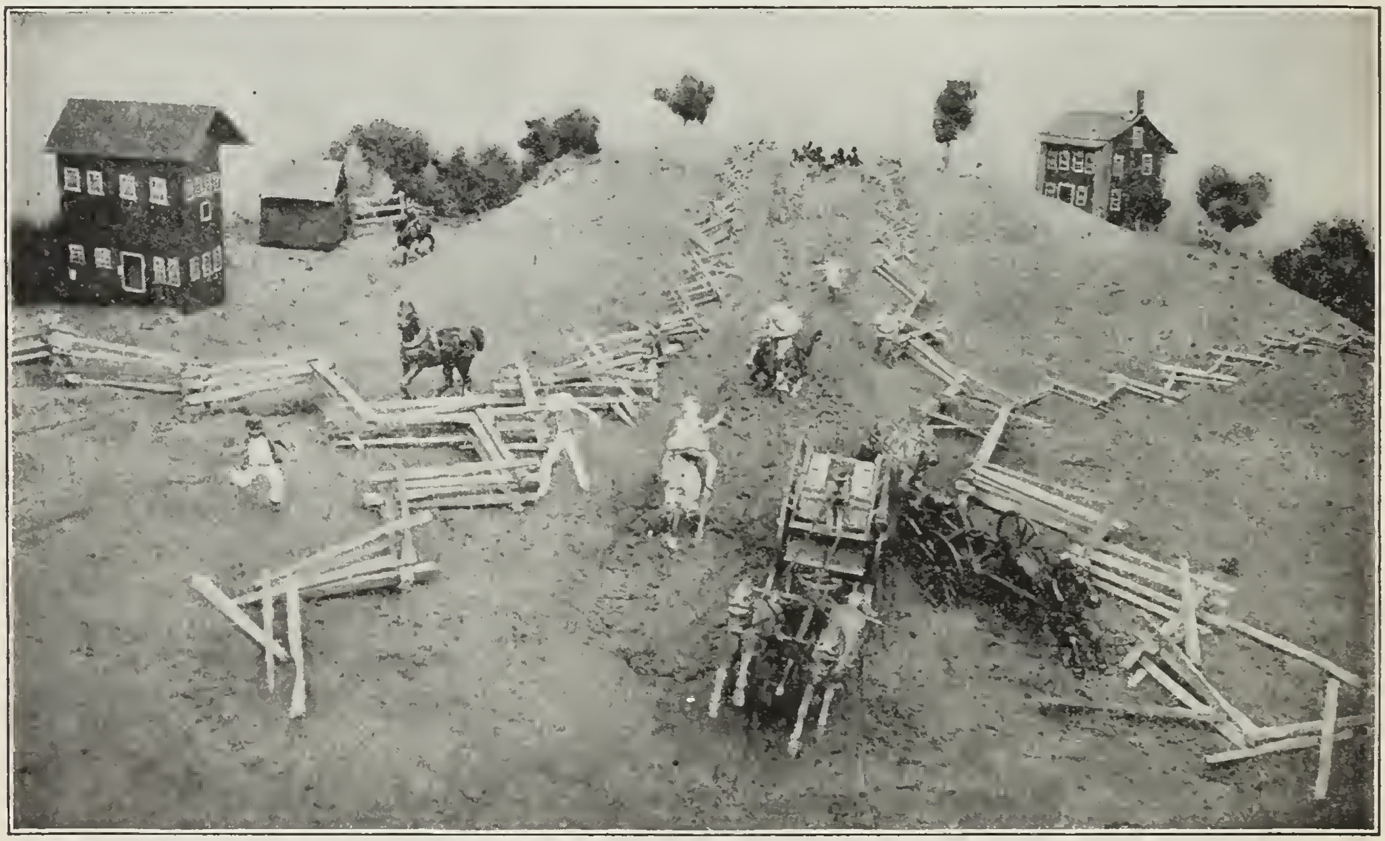
the background can be obtained in the picture of the Country Cross-roads.

A man could not place his foot lengthwise between the fences down at the corner of the road beyond the mill, although it appears to be wide enough to let several wagons pass one another there.

The other picture seen on that page shows the actual size of every object in the preceding one. If a tall man who stood where the little boy is sitting on the hassock should fall at full length, his head would bump against the muslin background which represents the sky.

Young photographers will doubtless wonder how the effect in the next view of the same scene was obtained, for it seems to make everything "as big as life." The camera was taken off its tripod, and placed flat upon the ground, so that the lens was on a level with the man and his pony. As every object was in proper proportion the illusion is complete.

As we constructed these scenes of mimic strife



THE ROUTED "ARMY OF THE KANKAKEE."
("The soldier riding backward down the hill is 'General Calamity,' who has vowed never to turn his back to the enemy.")

our imaginations were active. Our handful of brave soldiers (mostly generals) were always confronted by a great force of the enemy, but held them at bay with the single brass cannon.

These pictures are but the beginning of what promises to be a most fascinating play for "grown-ups," as well as little folks; and we have already planned to build mountain scenes with lakes and waterfalls, forests and rivers, and deserts and farm-yards. We mean to be great travelers, and see strange sights in this little fairyland in our back yard. That is the only way in which we can get deeper knowledge of such an interesting mimic world.

AN ATTEMPT TO RALLY THE "ARMY OF THE KANKAKEE."

The fat little man in his shirt sleeves, in the picture on this page, astride a fiery horse, is "General Stebby."

Uncle Arthur says that the man about to fire the cannon is himself, as he always fired the cannon in the "Army of the Kankakee."

THE FIRST PAPER CANOE

BY H. E.

When I was a boy and lived in England, a young friend taught me to make a little boat out of a piece of paper, which for ingenuity and completeness is the neatest piece of paper-folding that has ever come under my notice. Very often I amuse my child friends now by folding one for them, and many a fleet of paper barges I have made, on the shore of some little pond, which, wafted by summer breezes, have carried their young owners' ventures over to the farther shore —some laden with the treasure of a cent, like Spanish galleons making their way across their mimic ocean. Generally the voyage is successful, for they are stanch little craft.

I have seen many children who could fold as far as the "catamaran," which is one of this series; but the catamaran has no sail and drifts aimlessly about. Though there may be, and doubtless are, children in America who can carry the series through to the complete "barge," with its cabin and sail, I never met with any of them. It is an intricate piece of folding and doubling, and I have often wondered who made the first one, and how surprised he must have been when he saw the result of the last step. Was the first one made of papyrus on the shore of the Nile, or did the deft fingers of some citizen of the Celestial Kingdom make it for a journey down the Yang-tse Kiang? Who knows?

Intricate as the foldings are, with the help of the illustrations, which show every step, any smart boy or girl can make the little vessel.

Fig 1

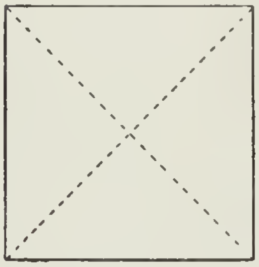


Fig 2·

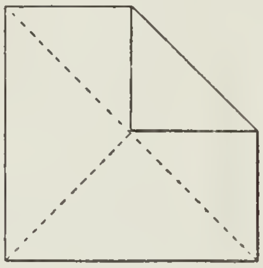


Fig 3

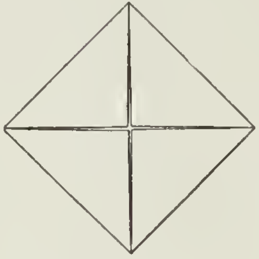


Fig 4

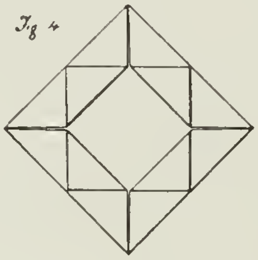


Fig 5

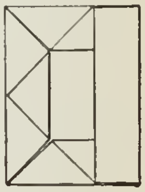


Fig 6

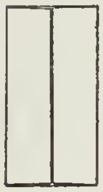


Fig 7

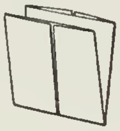


Fig. 8

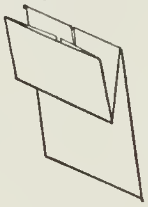


Fig 9

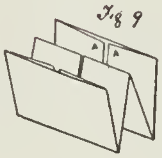


Fig 10

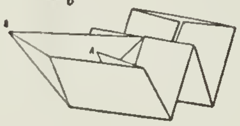


Fig. 11

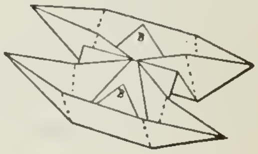


Fig. 12

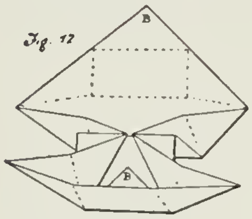


Fig. 13

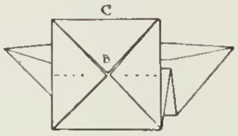


Fig. 14

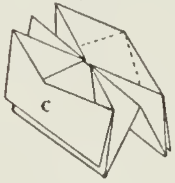


Fig. 15

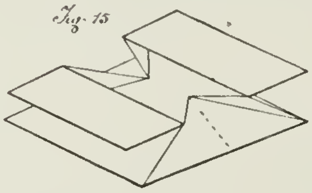


Fig 16

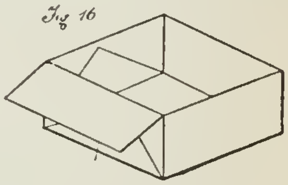


Fig. 17

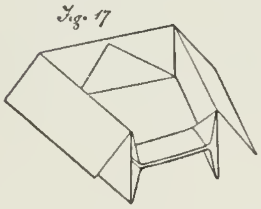


Fig. 18

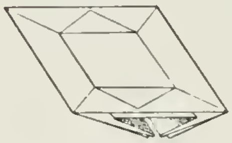


Fig. 19

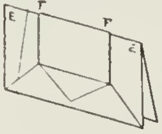


Fig. 20

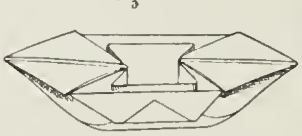
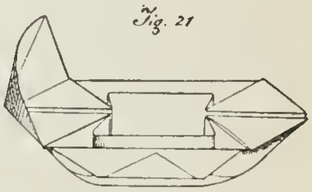


Fig. 21

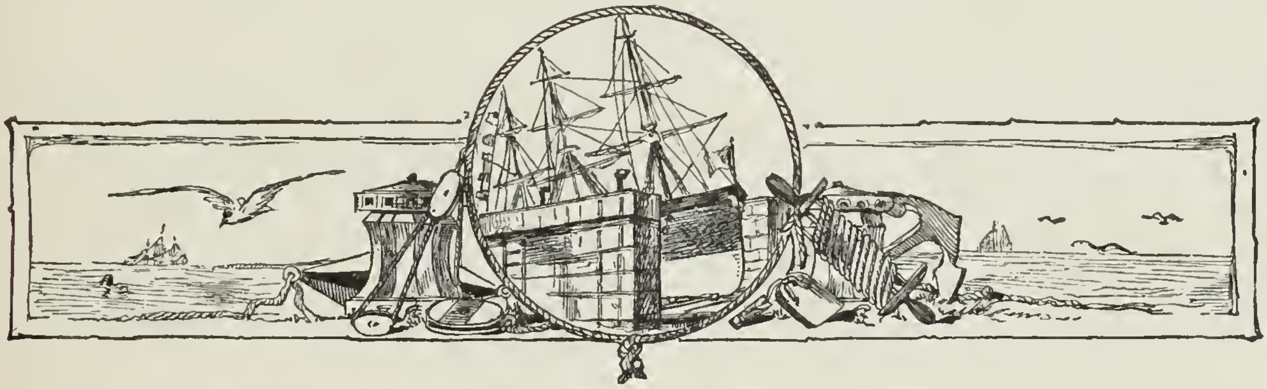


Take a piece of thin and pliable paper and from it cut a square of from four to six inches; the more exactly square it is, the neater will be your barge when completed. Double it over from the opposite corners to get the exact center, so that your square looks like Fig. 1, in which, as in all the illustrations, the dotted lines show creases. Then fold each corner down precisely to the center, as in Fig. 2, so that when all the corners are folded you will have Fig. 3. Smooth all the creases down with your thumb-nail closely. Next turn back each corner to the middle of the newly formed side where it is marked by the crease, so as to open the center; then you have Fig. 4. Now fold two opposite sides over to the middle (Fig. 5), so that when both are folded, you have Fig. 6. Then double it back on itself with the edges of the folds outside, as in Fig. 7. Rub all the creases down with your nail so that the folds are all smooth and true and that the paper will stay in shape. Now bring the edge of one side up to the middle crease (Fig. 8), and do the same with the other edge, and you will have Fig. 9, in which your paper is like a W with the edges inside. The symmetry of your finished work will depend largely upon the care you take to make each side of the W of the same length. Your next step is a little more intricate, for you now begin to unfold. Lay the paper down on the table, and open the top fold while you hold the rest down with your finger, and you can open the corner as in Fig. 10, in which the sharp projecting corner A is formed, in fact forms itself as you spread it open, from the correspondingly marked corners not picked out in Figs. 9 and 10. By opening each fold and bringing out all four corners, you have the catamaran, Fig. 11. Though the catamaran is often made and put into the water, it is not a good boat, for it is not stiff enough and it soon opens out into a shapeless piece of paper.

The next step is to take hold of the corner B of the paper on the inside of the catamaran, and bring out the side into a large flap like the upper part of Fig. 12. Be careful not to tear it as you bring it out. This done, the corners of the flap are to be refolded *outside* (Fig. 13), and then the upper part of the flap C turned down as in Fig. 14. When this is done with both sides of the catamaran, and the center crease spread a little so that it can be placed astraddle of the finger, you have a pair of panniers (Fig. 14) like those which in Europe are used to place on donkeys' backs to carry vegetables to market.

The next step is to lay these panniers down on the table, flattening down the center crease, and pull on the sides of the panniers (Fig. 15). This will make the sides that join the two panniers rise from the flat bottom, and they can be nicely straightened out with the fingers into the box (Fig. 16). These boxes make nice little trays, the flaps being used for handles. We boys used to keep silkworms and other live things in them, turning the flaps over the top of the box for a lid; they can be pressed down a little way into the top and will stay very well. Just now, however, we will keep the flaps down, as in the farther one in Fig. 16, and take the next step. This consists in folding the side of the box down and out, bringing the top edge even with the bottom and following the fold along till it meets the ends of the box as shown in Fig. 17, pressing the crease nicely down with the fingers of one hand, while you support the end of the box with the other. When you have done this with both sides, you bend the ends of the box back under the bottom, and flatten it out carefully, and then you have the picture-frame (Fig. 18). Be sure that the bottom edges of the ends so turned over meet nicely in the middle at D, which they will do if you have conducted your operations neatly up to this point. Now double the picture-frame back upon itself, with the folds that formed the ends and flaps of the box inside, and the front of the picture-frame outside as in Fig. 19, and you are ready for the next step, which is a real transformation. Indeed, it is difficult to believe that simply pulling on such a plain shape as Fig. 19 represents can produce such a complicated object as is shown in Fig. 20. Hold the doubled-up picture-frame firmly with the thumb and finger of each hand at the points E E, and pull gently and firmly apart. As you pull, you will find that the fold you pull on will slide out from under the fold at F F, and what complicated foldings, unfoldings, slidings and doublings take place during this operation it is not worth while to describe; but the effect is that the whole thing assumes an entirely different shape without any assistance from the fingers, until, as if by magic, when the folds are entirely pulled out, we have our little barge as shown in Fig. 20, with its two little decks and square cabin, and little gangways on each side of it. The sails—for it has two—can be hoisted or furled at will. Fig. 21 shows one opened out. It is formed by pulling up the upper part of one of the decks, and when you have done with it, you can fold it together and put it back. When you sail your barge, you must put a little weight in it for ballast, else, like larger ships, it will lie over upon its side.

Bon voyage!



"SOME FLOWER IN BLOOM EACH DAY"

(From April to September)

BY ELEANOR A. SUTPHEN

A COLD spell about the middle of November brought a heavy fall of snow before Thanksgiving. This set the oldest inhabitants to telling of the winters when they were boys, while the youngest inhabitants gleefully pulled down their sleds from the attics, prepared to make the most of the Saturday holiday. The skating was still prime on the day after Thanksgiving Day, but most of the children were pretty well tired out; and on that morning several boys and girls were grouped before the library fire at the Carpenters', toasting marsh-mallows on hat-pins, and lazily talking over the vacation fun.

The postman's whistle brought Jack to his feet. Stepping out in the hall to get the mail, he came back with a big brown envelop for himself and a letter addressed to Florence.

"From Uncle Jack," said his sister, looking at the postmark. Slitting the envelop with one of the hat-pins, she glanced over the contents, while Jack brought to light a catalogue from a well-known New England nursery.

"Listen!" exclaimed Florence, waving a check in the air. And then she read:

"MY DEAR FLORENCE: A day or two ago I ordered a catalogue mailed to Jack from the E—— Nursery. It will probably reach him about the same time that you receive this letter. I was much interested in hearing about your plans for a flower-garden. That bed in front of the hedge will be a capital place to plant a hardy border. I have been gardening for many years and if I can help you to profit by my experience, and save you a few disappointments, I shall be glad. So I am going to make you an offer, with two conditions.

"The conditions are that you and Jack do all the work yourselves and that you plant no annuals, but only the things which will come up again after the winter is over. There are several annuals which drop their seeds in the summer, and these seeds grow without any help in the spring. You may plant such things if you like. I am sending you two dollars to spend in seeds and plants, and now comes the offer.

"If, observing these conditions, and spending only the sum inclosed, you can plan a garden which will give you some flower in bloom each day from the time of the first bloom in April till the middle of September, I will promise to double the amount of my gift another year, sending you four dollars next fall, to make the garden still larger.

"Keep a record, setting down each day what is in bloom, and if you succeed only in part, I will make the reward in proportion. You would find a regular garden diary very interesting, but my offer does not require this.

"Send me a list of your purchases. I shall be interested.

"Your loving
"UNCLE JACK."

Comments were various as the reading ended.

"It can't be done," declared Harry King. "It would cost you half your money to get your bed dug up and fertilized."

"No, it would n't," said Florence. "Father had it dug up and made ready for the spring planting when he bought the place this fall."

"Two dollars would buy enough seed to plant the whole place with," said Jack, already deep in the catalogue. "These seeds are most of them only five cents a packet, and five goes into two hundred—"

"Oh, Stupid," laughed one of the girls, "do you suppose your seeds are *all* going to grow?"

This caused a general laugh, for Mollie had invested heavily the previous year in packets of seeds sold at the school, but only a scraggly crop of sweet alyssum had rewarded her efforts, for the poor seedlings had first been nearly drowned, and then had suffered from drought, owing to Mollie's forgetfulness.

"Of course we 'll try, Jack?" asked Florence.

"Sure thing!" exclaimed the boy. "Uncle Jack has worked this thing out himself, or he would n't put it up to us. But it 's going to take some pretty close figuring."

"Get a pencil and paper, and we 'll all help," suggested Mollie, and Harry also promised his valuable advice. The rest of the party went off to the pond, Harry going with them as far as the corner. He ran up the steps of a pretty cottage, soon reappearing with a catalogue, a duplicate of the one just received by Jack.

Dashing into the library out of breath, he burst out: "Mother says if we 'll come over there when you get your list done, she 'll help you."

"That will be dandy," said Jack, "for she knows a lot, but let 's plan the whole list before we go to her. Then she can suggest changes."

Jack produced from the desk a big piece of foolscap which he handed to Harry. "I can't letter as well as you do. Please rule it off for us in four spaces, with a half-space at each end."

"What for?" interrupted Florence.

"Just wait and I 'll show you," answered Jack, who was very systematic.

Silence reigned while Harry carefully drew his lines. "Now then," said Jack, "over the first half-space write April, because we don't begin till the middle of April; then head the full spaces May, June, July, and August, and the other half-space is for the half of September."

"But what shall we do next?" asked Mollie.

"You and Florence take one catalogue, and we 'll take the other, and we 'll look under the list of plants and find what things bloom in April, and write them in that space. Then we 'll make a list for May, and so on."

"But we can't buy them *all,*" objected Florence.

"No, of course not, but we shall know then what we have to choose from," said Jack.

"There does n't seem to be much choice for April," came in a dubious voice from Mollie. "Forsythia has beautiful yellow flowers, but it 's a bush, and one would cost thirty-five cents, and you 'd have to pay express charges to get it here."

"We don't want any shrubs, anyhow," said Jack; then he added: "Say, Harry, your birthday is the 20th of April, and don't you remember those things your mother had blooming in her garden then?"

"Tulips!" shouted Mollie, Harry, and Florence.

"Put 'em down for April," commanded Jack.

"The narcissus comes even earlier than the tulips," remarked Mrs. Carpenter, coming in for a moment. She had been told of Uncle Jack's offer while Harry had gone for the second catalogue, and was greatly interested in the plan.

"Would n't it be a good idea," she suggested, "as you go along, to write down the price of each plant? Then you won't have to go through the whole catalogue again when you calculate costs."

After she left the room, the four worked busily for a few minutes, and Harry held up the April entries for inspection.

On account of expense the items had been reduced to two, which read:

Narcissus @ $.30 per dozen
Tulips @ $.40 " "

By dinner-time a list had been filled in for each of the other months, and June was so full that it had to be continued on the other side of the sheet. Many favorites were left out because they were annuals, but there still was a great variety to choose from.

So enthusiastic were the children that Mrs. Carpenter asked Harry and Mollie to stay to luncheon, that there might be as little interruption as possible.

The entire afternoon passed in the same interesting way. After a final revision of the list by Harry's mother, that night a letter was ready for Uncle Jack, inclosing the list of plants decided on, and explaining that in three cases seed was to be bought, as it was so much cheaper and these particular kinds of seed were certain to do well. This is the list:

½ doz. Narcissus	$ .15
½ doz. Tulips	.20
2 Pyrethrum (white and pink)	.30
2 Sweet-Williams (red and pink)	.30
2 Canterbury-Bells (lavender and white)	.30
2 Hollyhocks (pink and yellow)	.30
3 Phlox	.30
Seed:	
Ragged-Sailors (Centaurea) (mixed colors)	.05
Sweet Alyssum	.05
Gaillardia	.05
	$2.00

Uncle Jack wrote back that the list was fine; he could n't have done better himself.

Jack sent out an order at once to the New England nursery which Uncle Jack recommended, and he and Florence anxiously watched the mails till an answer came, and with it the three packages of seeds and the tulip and narcissus bulbs.

"The remainder of your order will be shipped by express in time for the spring planting," so said the letter, and until that joyful time, with the exception of planting the bulbs as soon as they came in the month of March, the boys and girls had to be content to plan the arrangement of the garden. Finally, growing very impatient, they started a garden diary, or brief daily record.

The place which Mr. Carpenter had bought was not entirely bare of shrubs and plants, but before this Jack and Florence had not thought of noticing them.

Mr. Carpenter picked up the diary one evening late in the summer and read here and there to Mrs. Carpenter, who sat near with her sewing.

"March 14. Last night first without frost.
"March 16. Saw three robins to-day.
"March 18. Found tulips up in bed by front veranda. Did n't know there were any there.
"March 19. Saw a bluebird.
"April 8. Heat, cold, snow, rain, thunder all in twenty-four hours. Such weather!"

Then in red ink came an entry which marked the official opening of the season:

"April 15. Narcissus in bloom!"

Two days later a yellow tulip unfolded, and from here on there were daily entries.

On the 28th of April the plants had come by express, and Mollie and Harry had come over in the afternoon to assist at the ceremony of the "official planting."

"This has been the best observation-party that I ever knew anything about," said Mr. Carpenter, laying down the book with quite a jaunty air of satisfaction.

The last week of September Uncle Jack received quite a fat letter one morning, which brought a pleased smile to his face.

"Is that from Jack?" asked Aunt Nell.

"Yes, and the youngsters have won out."

"Oh, I 'm *so* glad!" she exclaimed. "I feared they would be discouraged and give up. You did give them a pretty big piece of work, I think."

"It did them good," was the reply. "Jack says:

> "Sometimes we 've been almost beaten, but we 've weeded, and dug, and watered to make things grow, and we 've had to fight some hungry bugs. We went up to the greenhouse, and Mr. Gardiner gave us stuff to kill them.
>
> "Then several times the next-door chickens got in and had a good time, and one lovely morning Chick Chester's puppy came over and tried to dig down to China, and had to get a sweet-william out of the way so as to begin in the right place.
>
> "But we 've won out, and have our garden diary to show you when you come next month.
>
> "We inclose a time-table, to show you the order in which everything bloomed.
>
> "Your affectionate nephew,
> "JACK CARPENTER."
>
> "P. S. Florence sends love and thanks.
>
> "P. S. No. 2. We have a list ready of things we want to get next year when we have the four dollars. Don't you think we had better spend some of it this fall on fertilizer?"

"That was one of the best investments I ever made," declared Uncle Jack, "and the time-table of bloom is worth keeping."

As Uncle Jack's opinion seemed valuable, the time-table is herewith reproduced, with the hope that it may encourage other gardeners like Jack and Florence to try for large results from a small investment.

April 15–May 10	Narcissus	White
" 17– " 9	Tulips	White, Yellow, Orange
May 8–June 15	Pyrethrum	White, Pink
" 27–All Summer	Ragged-Sailors	White, Blue, Pink
June 6–July 10	Sweet-Williams	Pink, Red
" 13– " 5	Canterbury-Bells	Lavender, Pink
" 23–All Summer	Sweet Alyssum	White
" 28–July 10	Hollyhocks	Yellow, Pink
July 2–August 15	Phlox	White, Pink
" 6–All Summer	Gaillardia	Yellow

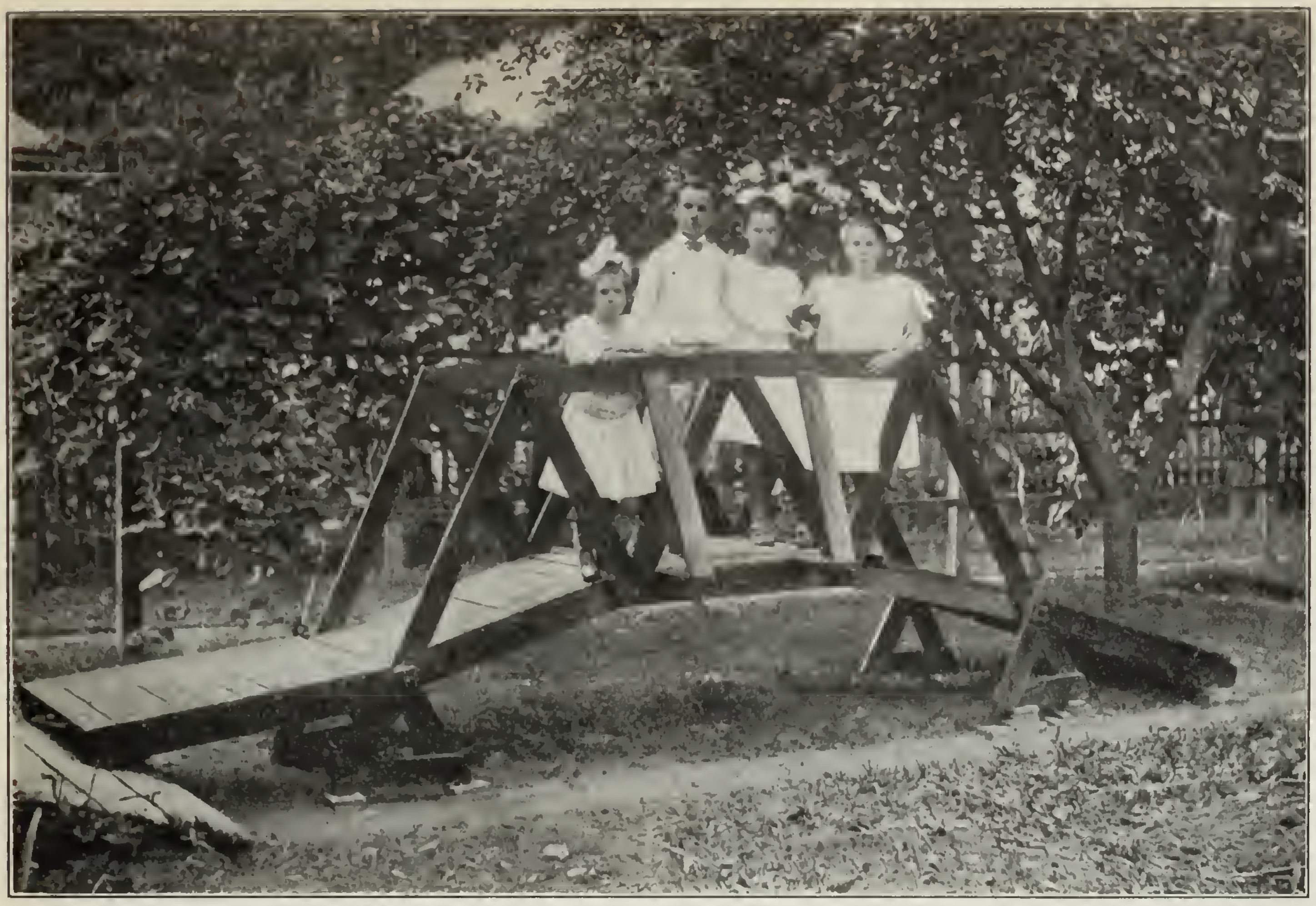


FIG. I. THE COMPLETED BRIDGE.

A BOY'S OWN BRIDGE

BY EDWIN J. PRINDLE

SIDNEY had always been fond of using tools, and when his family moved to a new home, the lumber that was used for crating the furniture gave him plenty of material to work with. His father thought he could plan a bridge that would be the same in principle as a real "truss" bridge, and yet would be simple enough so that Sidney could build it, even though he were only twelve years of age. There was no real need of a bridge in the back yard, but a river could, of course, easily be imagined as flowing across the path to the barn. A pencil drawing of the bridge was made, and it looked rather hard to build before he started; but, like most work, as soon as he had made a beginning, it commenced to seem easier.

All the tools he used were a brace and bit for boring the holes, a saw, a hammer, and a try-square, for marking straight across the boards to saw their ends square. The lumber was all four inches wide and one inch thick, and it came in various lengths. Except for the flooring and four side braces, all that had to be done to any board, after sawing it the right length, was to bore two holes in it, for they were simply held together by bolts and were not nailed in any way.

The bridge is what is known as a "truss" bridge, like most railroad and highway bridges. The first thing done was to saw the eleven boards for each of the two sides, or "trusses," making each board three inches longer than the distances between the two bolt holes it was to have, and then to bore the bolt holes an inch and a half from each end. Sidney got so interested that he could hardly sleep, and he was up and at work before breakfast, boring the bolt holes in all the boards, as this could be done without making enough noise to awaken the older people. When the boards, except the flooring, were all ready, the boards to form one side, or "truss," of the bridge were laid flat on the ground in the position shown in Fig. 5 and were bolted together. All the bolts were five eighths of an inch in diameter, and bolts four and a half inches long were used where four boards came together, and three and a half inch bolts where three boards met. The A-shaped supports and the boards for the approaches were then bolted on at the same time. When the first side was completely bolted together, Sidney leaned it up against the wall, and stood upon it to see if it were going to be strong enough. It showed no signs of giving way. The two sides were then stood up vertically, and for the moment held by strips nailed across from one to the other, for he was determined to build the bridge entirely with his own hands and would not let any one help him hold the sides. Then the flooring was sawed and nailed on, and as each piece was nailed in place, it seemed to make the bridge stronger. Finally the four side braces were put on. The bridge then had two coats of paint. The joy of that proud moment when he stepped on the finished bridge, and felt it firmly support his weight, and knowing that he had made it entirely alone, amply repaid all the work it had taken.

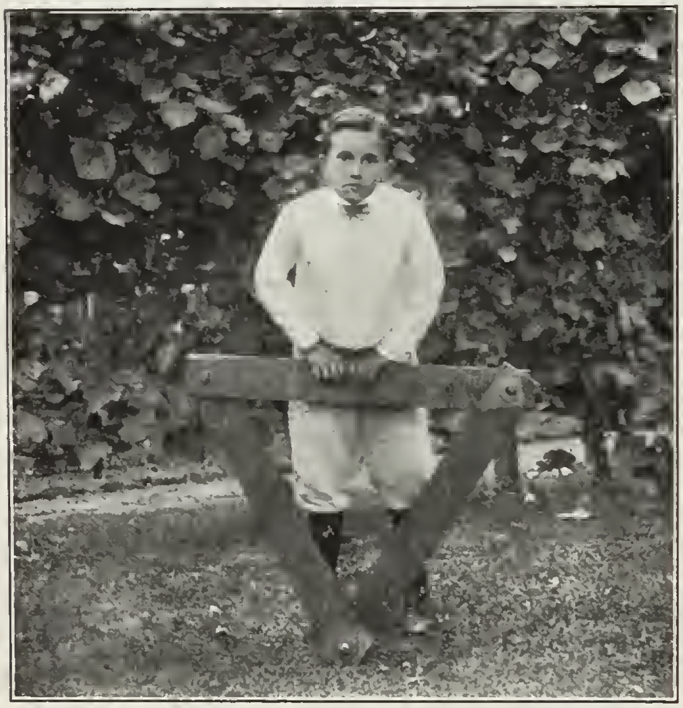


FIG. 2. SHOWING THE RIGIDITY OF A TRIANGLE.

The cost of the bridge was seventy-two cents for bolts and washers, and eighty-five cents for paint. Sidney's mother says that, to be strictly correct, the cost of two shirt-waists, half a dozen towels, and a cake of sand soap should be added.

This bridge has held three grown people at one time, and four children at another, and could easily have held more. Its span is about nine feet between the supports. Why is it that such slender boards can hold so great a weight over so long a span? What is it that enables a railroad bridge looking like a spider web to hold an enormously heavy locomotive and train? It is because every bit of material in a truss bridge is put in the very best position to enable it to use its strength to the greatest advantage. I will try to make this clear.

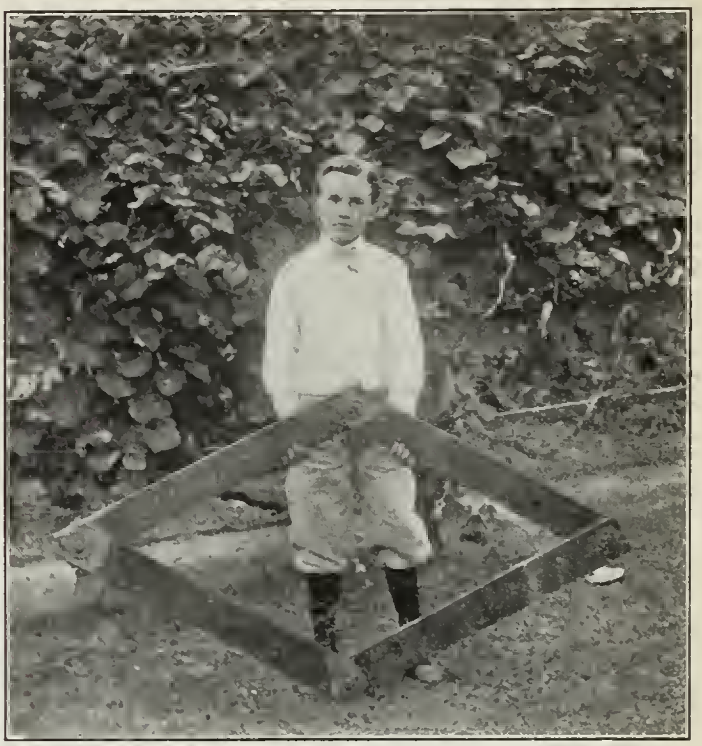


FIG. 3. A FOUR-SIDED FRAME WILL COLLAPSE IF NOT SUPPORTED.

You will notice that the sides, or "trusses," of the bridge are made up entirely of triangles, or three-sided figures. There is an object in this. A triangle cannot change its shape unless one or more of its sides is lengthened or shortened. Fig. 2 shows that the triangle is stiff and will bear weight up to the limit of its strength without changing its shape. The first picture of the four-sided figure, Fig. 3, shows that the boards

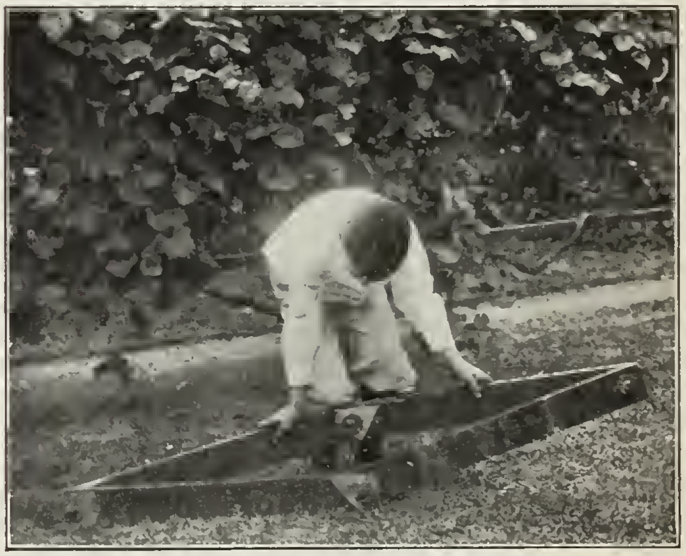


FIG. 4. THE COLLAPSED FOUR-SIDED FRAME.

must be held up to keep them from shutting up by their own weight, while the second picture, Fig. 4, shows what happens when any weight is put on the four-sided figure. Now look at Fig. 5 on this page.

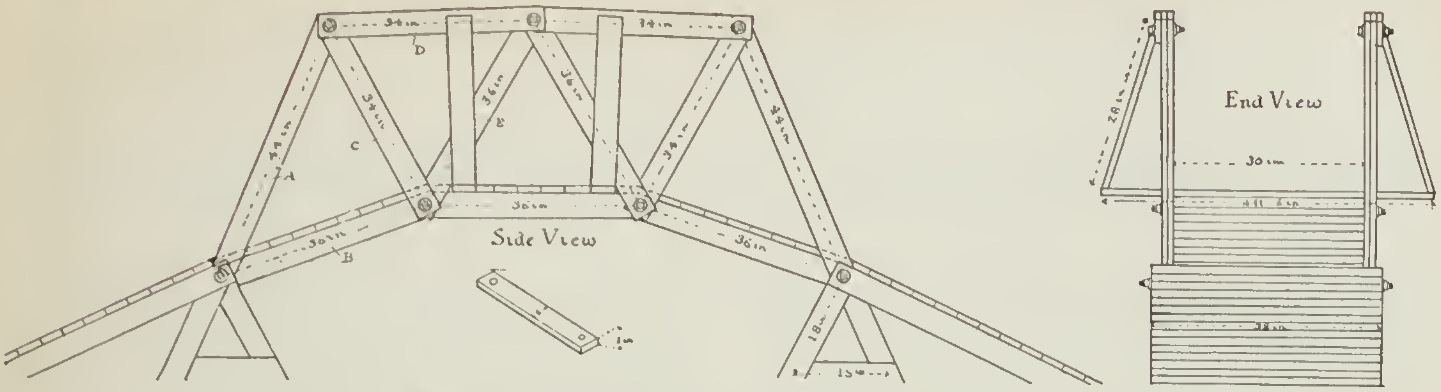


FIG. 5. WORKING DIAGRAM OF THE BRIDGE, GIVING DIMENSIONS.

Since the triangle does not change its shape, we build the bridge entirely of triangles. The first triangle at the left is made up of boards A, B, and C, and rests on the little pier, or support. Then the second triangle, which is made up of the boards C, D, and E, is formed by bolting the boards D and E to the ends of the board C, and so across from one support to the other, the truss of the bridge is made up of triangles bolted together. As no one of the triangles can change its shape, and as they are all bolted together, so that they cannot move on each other, they make a stiff framework much the same as if they were one solid board as large as the truss. The lengths of the parts of the bridge are given in Fig. 5. Bear in mind that these dimensions are what the engineer calls "between centers"—in this case, they are the distances from the center of one hole to the center of the other. Each piece of board, as has been said, should be one and a half inches longer *at each end* (three inches in all) than the distance "between centers."

Each board is simply fastened in place by a bolt that passes through each end, and so the board can only be pushed or pulled in the direction of its length. There is nothing trying to bend the boards of the bridge trusses sideways. A board will support a much greater weight if it is stood on edge under the weight than if the weight is laid on the side of the board while the board rests at its ends on supports. And the board will support a still greater weight if the board is hung up by its upper end and the weight is hung on its lower end. So a board will stand more strain if it is pulled, or pushed, in the direction of its length than if it is bent sideways. As each board in the truss is only fastened in place by a single bolt at each end, around which it is free to turn, the boards can only be pushed, or pulled, in the direction of their length, for you can't bend a board sideways that way. So you will see that the boards are all put into the bridge in the way in which they are strongest.

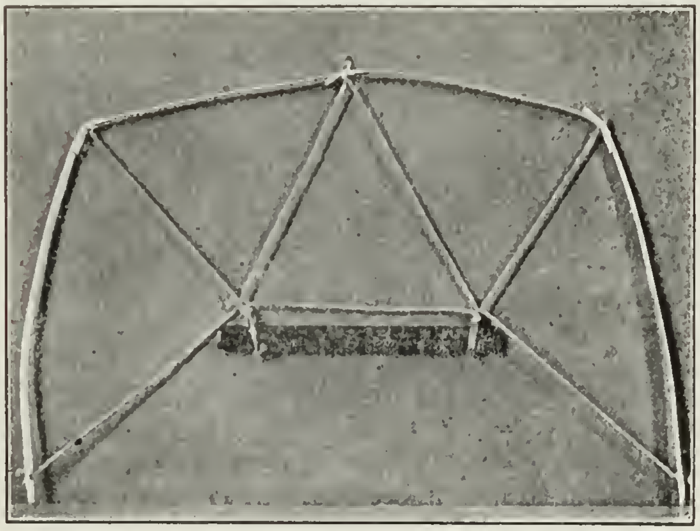


FIG. 6. A PAPER-AND-STRING MODEL OF A TRUSS BRIDGE.

The paper-and-string model, Fig. 6, of the bridge truss is holding a piece of lead-pencil; and it shows that only the four boards that make up the "upper chord" of the truss are pushed on by the strains in the bridge shown in the model by their being bent, while all the other boards are simply pulled on. In a steel bridge, the pieces corresponding to the strings would be made of light, slender rods, while only the upper chord would have to be made of stiff beams.

INTERESTING QUESTIONS AND ANSWERS

WHAT IS THE DIFFERENCE BETWEEN HARD WATER AND SOFT WATER?

The difference between these two kinds of water is that the hard water contains certain salts not found in soft water. These salts are almost always salts of lime, which the water has picked up from the earth as it passed through it. So we understand that they are not found in rain-water, which is therefore soft. Hard water is very good to drink, as a rule, but the only objection to it is that it interferes with the use of soap, so that the water is not good for washing purposes.

When soap is used with hard water a chemical change occurs, so that the soap is turned into something which does not dissolve in water; whereas soap used with soft water produces something which dissolves in the water, and forms a splendid lather, and so is good for washing with. This makes a great deal of difference to poor people, or to any one who washes clothes at home, because soap used with hard water will not lather and is very nearly all wasted, and things cannot be made clean. We can easily tell whether water is hard or soft by adding soap to it.

WHAT MAKES THE EARTH GO ROUND THE SUN?

There are really two questions here. If we grant that the earth is moving at all, the reason why it moves round the sun, and not in a straight line, according to the first law of motion, is that though, so to speak, it always tries to move in a straight line, the force of the sun's gravitation always turns it in toward the sun. But the other question is: What makes the earth go at all?

The sun's gravitation is certainly not the answer to this, for if the earth became still the sun would pull it into itself at once. There is some other source of the earth's motion, which was imparted to it or present in it when it was formed, and which throughout all the ages has not been done away by friction—since, as it appears, there is no friction as the earth swims through the ether. If there were any, surely by this time the earth would have been slowed down much faster and would have rushed into the sun.

This original motion with which the earth began, and which it still has, must have the same origin as the earth's twisting motion on itself, the motion through space, and the twisting motion of the other planets, and the twisting motion of the sun. For the source of all this motion, we must go back to the source of all motion and all power—back to the Author of all things. This is only to say, in other words, what used to be said long ago when it was thought that the solar system was created as it now is, each planet being "launched in its orbit from the hand of God." Orbit comes from the Latin word *Orbita,* meaning a path.

WHAT IS THE AURORA BOREALIS?

For many years past people have inquired as to the cause of the wonderful brilliance called the Northern Lights, or *aurora borealis,* sometimes seen in the north by people in some parts of our land, and still more by those who live farther north than we do. In seeking to find out what causes it, we must first begin by studying the light of the aurora borealis, and we must do this by means of spectrum analysis. When that is done, we find that the light must have come from atoms of certain elements which form part of the air. These elements have only been known for a few years, and most of them were discovered by Sir William Ramsay. They mostly exist in the upper layers of air.

If we take a collection of these gases, and run some electricity through them, we find that they glow with certain beautiful colors which, indeed, make a very good imitation of the aurora borealis on a small scale. We are therefore inclined to believe that the aurora borealis must be due to electricity somehow exciting these gases as they exist in the upper layers of the air, and causing them to produce this glow.

IS SMELL A WAVE IN THE AIR?

This is a deeply thoughtful question. It is the people who ask questions of this kind that help the progress of knowledge, because they are questions that show that the person has been thinking. Sound, as we know, is a wave in the air; and the heat we feel when we stand in front of the fire is a wave in the air; and light is a wave in the ether, passing through the air.

If, then, these waves explain seeing, and the feeling of heat, and hearing, why should they not also explain smell? But, in point of fact, smell is not a wave in the air. The great point about smell and taste, which go together, is that they are what are called *contact senses.* They are due to the actual *touching* of the tongue or part of the nose by particles of certain kinds. We cannot smell or taste at a distance. Of course, any one will say that that is untrue about smell, but it is not. We seem to smell at a distance when we guess where the smell comes from; but, in fact, the tiny parts of the thing that has the smell have traveled through the air and have reached the smell-part of the nose. This is utterly different from the cases of the other senses. Smell would be like hearing if we smelt a grain of musk or an open bottle of scent in a room because the musk or the scent started special waves either in the air or in the ether. They do not; but portions of themselves are carried through the air to our noses.

WHAT MAKES A WATCH GO?

The great law about power and energy, which we so often have to refer to, gives us the answer to this question. There is power in the spring, which gradually communicates itself to the wheels of the watch, turning them, and making them move the hands that we see. After a time, perhaps hours, or even days, the watch stops, because the power of the spring has come to an end. It has spent itself in moving wheels, in moving the hands of the watch, in overcoming the friction at the places where the wheels and the hands are balanced, or pivoted, and in moving the air in the watch and overcoming its resistance.

As no power can come from nothing, every imaginable kind of watch or clock must, sooner or later, have fresh power put into it.

The power was put into the spring when the watch was wound up. We wound it with our muscles, spending force obtained from food, which, in its turn, obtained the force from the sun. So the sun really drives the watch. When we wind a watch, we feel that we are pressing against something. If it has quite run down, the first turn causes little effort to our fingers, but the last turns need more. What we are doing is simply coiling a spring tightly. It uncoils itself in a regular way, with the help of what is called a balance-spring, and so gives to the wheels of the watch the power we put into it. When the spring is bent there is something in the strained arrangement of its parts which is the equivalent of power, and which can be transformed into power.

WHAT KEEPS A CANNON-BALL FROM FALLING TO THE GROUND?

Not only does the cannon-ball not fall to the ground at once when fired, but it always travels in a curve of a certain kind, and all things travel along paths of this particular kind when they are thrown forward.

The path taken is the result of the working together of all the forces that act on, or in, the ball. If the ball were simply allowed to roll from the mouth of the gun, it would fall at once to the ground, for the only force then acting upon it to any extent would be the pull of the earth.

But when the ball is shot from the cannon, it leaves the cannon in a certain direction and with a certain amount of force, and though Newton's law of gravitation says that the earth is pulling the ball, his first law of motion says that every moving thing tends to move onward in the same straight line at the same speed for ever.

The actual path of the cannon-ball is the result of the acting together of these two forces. Sooner or later gravitation gets the upper hand, especially as the resistance of the air helps it; but for every moving thing—a cannon-ball, or an atom of gas in the air, or anything else—there is a certain speed at which it would leave the earth altogether

WHY DOES OIL FLOAT ON THE SURFACE OF WATER?

It seems very curious at first sight that one liquid should be able to float on the surface of another; but if we think carefully about it we see at once that whether a thing floats on the surface of water or not depends upon one or two things. First, it depends upon whether it is soluble—that is, will dissolve—in water or not.

For instance, if we put a piece of salt in water it disappears, because the salt is soluble in the water. If, however, we put a piece of light wood on water it floats there, because it is not soluble, and therefore remains intact, and also because the weight of the piece of wood is less than an equal piece of water. It is much the same with oil. Oil and fat are quite insoluble in water, and as the oil is considerably lighter than the same bulk of water, it floats on the surface.

WHY DOES IT TAKE MORE POWER TO STOP A TRAIN THAN TO START IT?

We might extend this question by asking why it takes more power to stop the train the faster it is going. We find, indeed, that the power required to stop the train depends on the mass of the train, and on its speed. The greater these are, the greater is the power in the train, and the greater will be the power that is required to stop it, for this must be exactly equal to the power in the train.

When a train is at rest, the power required to start it depends simply on the weight, or, to use the best word, the mass, of the train. We all know that it takes more effort to move a heavy thing than a light one. We know, too, that it is one matter to let a heavy thing rest on the foot, and another matter to let it fall on the foot; and the greater the height it falls from, the more it hurts. That is because the greater the height from which it falls, the faster it is moving when it strikes the foot.

Such a case teaches us that movement adds power to anything; and that is so, for movement is itself a form of power. More than that, the greater the weight of the moving mass, the greater is the power that was required to move it, and therefore the greater is the power required to stop it.

WHAT MAKES THE SEA ROAR?

Roaring is a kind of sound, and though sound is a something that can travel in all kinds of matter, it is usually, as we know it, a wave in the air, because, as a rule, our ears are not pressed up against any solid thing, nor are they under water, and so all sounds that reach them must reach them through the air. This is true when we hear the sea roaring, though a swimmer, when he goes head first through a wave, may hear a roaring coming through the water when he is below the surface. Everywhere the surface of the water is in contact with the air, and if the water moves at all violently it may start in the air those kinds of waves which our ears can hear and which we call sound. These waves are of the kind that are not very numerous in each second, and so they make sounds of low pitch which we call roaring. Sometimes, when a wave breaks, a great volume of water may fall upon the rest of the water, and so make a sound which is more like an explosion than a roar.

Tennyson wrote once about what he called "the scream of the maddened beach"; and it is very interesting to notice that we do hear on the beach sounds which are much more like a scream than a roar, though the sea itself never screams. It is the beach, and not the water directly, that makes the scream, and the kind of scream will depend on the kind of beach. Soft sand will not scream, but where there are pebbles of certain kinds, as the waves move up and down they rub the pebbles against each other, and that produces air-waves of a quicker rate, which may be likened to a scream.

WHY DOES WATER SWELL WHEN IT IS HEATED?

It is not true that in all cases water swells when it is heated, because if we take water at the freezing temperature, and then slowly heat it, we find that, instead of swelling, it shrinks until it reaches the point which is called 4 degrees on the centigrade scale of temperature; that, however, is a special exception, and it is perfectly true that if we go on heating the water after 4 degrees centigrade, it does swell. This is true not only of water, but also of almost anything, whether a solid or a liquid or a gas.

We can find some kind of explanation for this if we think of heat as a to-and-fro motion of the tiny parts of which all matter is made. The hotter the thing, we suppose, the wider is this to-and-fro motion of its tiny atoms.

Suppose we have a crowd of children, and all the to-and-fro motion each of them makes is just so much as is required for breathing. Fifty such children could be packed together into a very small space; but if, instead of making only this little movement, each of them wanted all the time to be making little runs of five yards backward and forward, we should plainly not be able to pack these fifty children into as small a space as before, and the bigger the run that each of them wanted, the more space they would require to take up.

If, instead of children, we think of the atoms of matter, and if we think of heat as these atoms of matter running to and fro, we shall see why water and other things swell when they are heated. No one knows what special arrangements are made in the case of water between 0 degree and 4 degrees centigrade.

WHY DOES SHALLOW WATER FREEZE FIRST?

When the air is very cold, it gradually takes heat away from the water which is exposed to it, and so that water becomes colder. The earth beneath the water is much warmer, as a rule, than the freezing air, and so we expect to find the coldest water at the top, where the heat is being lost, and the warmer water below.

When water is cooled from 4 degrees centigrade down to the freezing-point, it does not get heavier, and so sink, as we should expect; if it did, a pond would freeze from the bottom upward. On the contrary, it gets lighter and floats, and so a pond freezes at the surface. But, short of cooling the water down so near to the freezing-point as 4 degrees centigrade, the water is, of course, becoming heavier all the time it is cooling, and, being heavier, it must sink, while the warmer water takes its place at the top.

This means that the whole thickness of the water must be cooled down before any of it will freeze, and therefore the shallower the water is, the quicker it will freeze. The little puddle in the road freezes quickly, but the deep pool will not begin to freeze until the whole depth of its water has been cooled.

WHY IS RUNNING WATER PURER THAN STAGNANT WATER?

Though we think of water as a thing which does not do much, yet, in point of fact, it is always doing things. It is the great supporter of life, in the first place. Also, it is the great dissolver of gases and of solids from the air above it, and from the ground beneath it, and these gases and solids help to support life. So stagnant water very quickly becomes filled with living creatures and with the products of their lives. We call it impure just because that does not happen to be the kind of water that we prefer to drink. But really, though we give it a bad name, it is doing the great work of water on the earth.

Even the water we call pure contains a great number of other things in it besides water, and that is especially true of running water, which is rich in gases. It is probably not very long since running water existed in the form of rain, which is much the purest of all the natural forms of water, although it also contains a certain amount of dust, and always a certain quantity of the gases in the air dissolved in it.

It is the gases in running water that make it so nice to taste, and this really makes more difference than we think. The Chinese long ago said that the proper way to make tea was with water taken from a running stream. If we compared such tea with tea made from pure distilled water, we should think the latter was a very poor drink indeed.

WHY DOES THE WIND BLOW MORE ON THE TOP OF A HILL THAN BELOW?

It is quite true that the wind blows more on the hills than below them, and travelers have reported that when they go to very great heights the wind becomes still more powerful. Where mountaineers have ascended as high as twenty thousand feet or more above the level of the sea, they usually find a tremendous wind blowing; and when the mountain is ascended on different occasions, this wind is always found to be blowing, and blowing in the same direction.

People who have gone up great heights in balloons have not noticed the same gale around them as mountaineers have; but that is because the balloon moves with the wind, and so the wind is not noticed, especially if it is a steady wind, and the balloonist at that height cannot always make out whether he is moving or not.

The explanation of all this seems to be that, as the earth moves, and different parts of it get heated in succession by the sun, and also owing to the movement itself, the air at a considerable distance above our heads is constantly moving and forming great winds. Lower down these winds are largely wiped out by the obstacles which the moving air meets on the surface of the earth, and also to some slight extent by friction of the air with the earth, which keeps the air moving in the same direction.

HOW CAN MEN FIND OUT WHERE A FAULT IS IN THE ATLANTIC CABLE?

We must imagine that, instead of an electric cable having a copper wire in the middle, we have a long tube, into which we pour water. We must imagine, also, that the end, or bottom, of the tube is hundreds of miles away, much farther than we can see. Even then we can tell how far off the bottom of the tube is if we know how much water we have to pour into it to fill it.

Just in this way clever men have found out how to tell the length of copper wire in an electric cable. They have instruments by which they can tell how much electricity has been put into a wire when it is full, and as they know how much electricity one mile or one yard of wire will hold, they can tell how far off is the end of the wire—that is, the place where it has broken.

WHY DO WE COOK OUR FOOD?

There are many good reasons why we should cook certain kinds of food. Perhaps the best is that cooking makes it softer and loosens it, so as to help our teeth. This is especially true in the case of meat. Another good reason for cooking food is that the cooking kills any microbes which may be in it, and some of which might do us a great deal of harm. It is certainly much better to boil, or cook, our milk, unless we are very sure where it comes from, and a great deal of the food that we eat now, especially people in cities, would certainly hurt us, by means of the microbes in it, if it were not cooked. A third reason why we cook our food is in order to make it look nice. This is especially true of meat. We have grown to dislike the look of red meat, and we prefer it cooked, so that the red color of the blood in it is changed. There is a very great deal to say about this interesting question, but there is no room for that now, and meanwhile you must think over the three answers given.

WHAT MAKES THE WIND WHISTLE?

The howling and whistling and all the other noises made by the wind are not heard as a rule when we are out of doors, but only when we are in a house. As the moving air forces itself through chinks of doors and windows, or perhaps even down the chimney, and so on, it sets all sorts of things that it meets vibrating or trembling, and so produces all kinds of sounds, and these are often almost musical. Often people are very much frightened by these noises, yet if they went out of doors into the wind itself they would not hear them. The wind passing through the air—that is to say, the current of air passing through the air—does not make itself known to us in sound because what our ears can hear is not a current, but a wave in the air. You cannot hear a draught.

WHERE DOES THE WIND BEGIN?

If the wind is a movement of part of the air through the air around it—and every wind is that—then we must find something which moves it; for we know that, in the case of the air, as in every other case, things which are at rest remain at rest until something moves them. The general rule about the wind is simply that it is the air moving from a place where the air is more dense or tightly packed to a place where it is rarer or less tightly packed.

People who study the weather understand how there are changes always going on in the pressure of the air at one place as compared with another; and all these changes must produce wind, since air is always moved from a place where its pressure is high to a place where the pressure is lower—somewhat in the same way as water will always try to form a level surface instead of being heaped up higher in one place than in another. If, then, we have an instrument—and the barometer is such an instrument—which tells us how the pressure of the air around us is changing, and whether it is low or high, we shall be able to guess fairly well what sort of weather we shall have, because we shall be able to guess how the wind will blow. In a slight breeze the moving air, which makes a wind, moves at such a rate as four or five miles an hour; say, a little faster than a good walker. In a gale the air will move as fast as an express train.

WHY DOES COLD WATER CRACK A HOT GLASS?

The reason why cold water cracks a hot glass is exactly the reason why hot water cracks a cold glass. But this does not always happen. If you use a very thin glass it will not crack either by cold water or hot water. The chemist very often uses little tubes made of very thin glass, which he calls test-tubes; and you can put these in a flame and boil water in them, without their cracking.

You might think that the thinner the glass the more readily it would crack, but really it is just the other way about. When you fill an ordinary tumbler with hot water, the heat is conducted from the water to the glass, and the glass expands or swells, but the heat has not yet reached the outside part of the glass, which stays as it was. And so, as the inner layer of the glass, which has been made hot, swells, it cracks the cold outside. Just the opposite happens when a hot glass is filled with cold water; the inside shrinks before the outside does, and so breaks it. But if you use very thin glass the heat gets through it so quickly, whether going into it or coming out of it, that it all swells or shrinks together and does not crack.

WHAT MAKES AN ECHO?

An echo is really a very simple thing, and when you know what sound is you can almost answer this question for yourself.

Sound is a wave in the air, and anything which will stop that wave and send it back again without altering its shape will make an echo. It is really much the same as the waves of the sea striking against a breakwater and coming back again. If the waves get broken up so that, instead of coming back as they went, they come back irregularly, then you will not hear a distinct echo, just as you will not see your face in a mirror plainly unless it is smooth. So the places where you get the best echoes are places where the sound waves are thrown back exactly as they came, just as the light waves are thrown back from a mirror. To make an echo, however, we must be standing far enough away from the wall, or whatever it is that throws the waves back, to give the ear time to hear the sound itself, and then to hear the waves as they come back.

WHY DID NOT THE EARTH BURN UP WHEN IT WAS A BALL OF FIRE?

We know that burning is the thing that happens when anything is combined with oxygen. We know, too, that many things when they are made hot will burn in this way. If these laws were true long ago, as they are now, the earth should have burned up, as you say. Well, the answer is that the earth did burn up almost entirely, so far as the outside of it is concerned. All the sea is burned; all the water everywhere has been made by the burning up of hydrogen, and most of this happened long ago, when the earth was cooling down from a ball of fire. Not only are seas and oceans burned, but the land is burned also. We cannot burn clay and rocks and stones, for the very good reason that these are the results of the burning up, or combining with oxygen, which went on as the earth was cooling down from its hottest state ages ago. Apart from things which have been made by life, such as coal, there is very little indeed of the surface of the earth that is not already burned; and it was burned just in the way that this question suggests.

WHY DO THE STARS TWINKLE?

Of course, you know that it is stars that twinkle, and not the other wonderful things looking like stars, which are called planets, and which, like the earth, belong to the sun's family.

The planets shine by the light of the sun, which they throw back, or reflect, from themselves, as the moon does, and, like the moon, they shine steadily. But the light of the stars is made by themselves, and comes over immense distances to us, so long that, as we have already seen, the light by which we see the nearest star left it something like four years ago.

It is likely that this light interferes with itself as it comes, so that it seems to come in little beats, and people who have studied this think that it is much the same as what sometimes happens with the piano or an organ when the sound seems to get louder, and then less loud, backward and forward. In the study of sound this is called a "beat," and it is probable that the twinkling of the stars is really the same kind of thing. It may be that the air has something to do with disturbing the light, and that perhaps starlight is more affected by the air than the sunlight by which we see the moon and the planets.

WHAT ARE THE STARS MADE OF?

Not very long ago, a very great thinker declared that this great question you ask me was one which men would never be able to answer, however long they thought and however hard they worked. Our telescopes could never tell us; the biggest telescope that could ever be made would never tell us.

It would only make the star look nearer and brighter, but would tell us no more what the star is made of than our eyes can tell us without a telescope. But now we have a wonderful instrument by which we can study the kind of light that is given out by any star that we can see. And since we find that the light of the stars, thus studied, is exactly the same as the light given out by things we know on the earth when they are made hot, we now know that *those same things* are found in the stars.

The answer is that the same kind of stuff of which this paper, and your eyes, and my ink and pen are made are to be found in the stars. The stars are made of the very same kind of stuff as the earth is made of. Of course, all the stars are not the same. Even with our own eyes we can see that some are redder and some whiter than others. Some have much more oxygen in them, and some less, for instance; but the point is that it is oxygen, the very same stuff as we breathe at this moment.

WHY DOES A NOISE BREAK A WINDOW?

The answer to your question is easy if you know what a noise is. It is an irregular wave in the air—which is a real thing, and has weight and power, remember. A wave of air may break a window exactly as the wave in the sea will break a breakwater, though, as the name tells us, the breakwater will break the wave, as long as that wave is not too strong.

If you think a minute, you will see that every time a noise gets through a shut window it shakes the window. If the noise is coming in from the street, the air outside is thrown into waves which pass through it until they strike the window, and shake it; then the window shakes the air inside the room in exactly the same way as the air outside shook it, only perhaps not quite so strongly. And so the noise reaches you, just as if you had heard it outside, only not quite so loud. Well, plainly, the noise has only to be loud enough—that is to say, the waves in the air have only to be big enough—to shake the window more than it can stand, and then it breaks. Now, I said that air is a real thing which has weight and power, and so the truth is that when you ask me why does a noise break a window you might just as well ask me why does a cricket-ball break a window!

WHAT MAKES A KITE FLY?

The case of the kite proves to us that the air has a great power of holding things up, since the kite has no wings, and yet it does not fall. The air supports it. If you took all the stuff of which a kite is made and rolled it into a tight ball, it would drop like a stone.

So it is not that the kite is made of something lighter than the air. A balloon flies, we know, because it is filled with something lighter than air, but the kite has no light gas inside it, and yet it does not fall. The reason is that it is spread out as wide as can possibly be, so that it may have a large surface for the air to support it. But, of course, if there were no air at all the kite would drop at once, just as the bird would, whether it were flying or not. Neither the kite nor the bird could rise or swim in nothing. Now, the Latin word meaning empty is *vacuus,* and a place that is quite empty, even of air, is called a *vacuum.* Nothing can soar in a vacuum.

HOW IS A CORAL ISLAND MADE?

Over thousands of miles in the Pacific Ocean there are groups of low, ring-shaped islands, and for a long time men have wondered how they were made. We know now that they are actually made of the hard parts of the bodies of countless millions of tiny living creatures belonging to the animal world. The stuff we call coral is really made of the skeletons of these little animals, all joined together. Coral islands have gradually grown upward to the surface from the bottom of the sea, as a result of the life and death of these tiny animals. They only live in water, and so when the coral ring comes to the surface and makes a coral island it stops growing. The tiny animals on the outside of the coral colony get most food, and so grow more quickly and their bodies are piled up faster than those on the inside. So the ring is formed; and often a few cocoanut trees find a footing upon it, the seeds of the trees being carried to the island by the wind. We can only guess how many ages it takes for a coral island to grow from the bottom of the ocean till it reaches the surface. Most of what we know about coral islands was found out by the English scientist, Darwin, and by Dana, an American.

WHY CANNOT FISHES LIVE ON LAND?

The answer to this is curious. Every living thing must have air or die. The fish comes out of the water, where there is very little air, into the air itself, and there it dies for lack of air. It is drowned on land for lack of air, and dies of what is called suffocation, just as you or I would be drowned in the water.

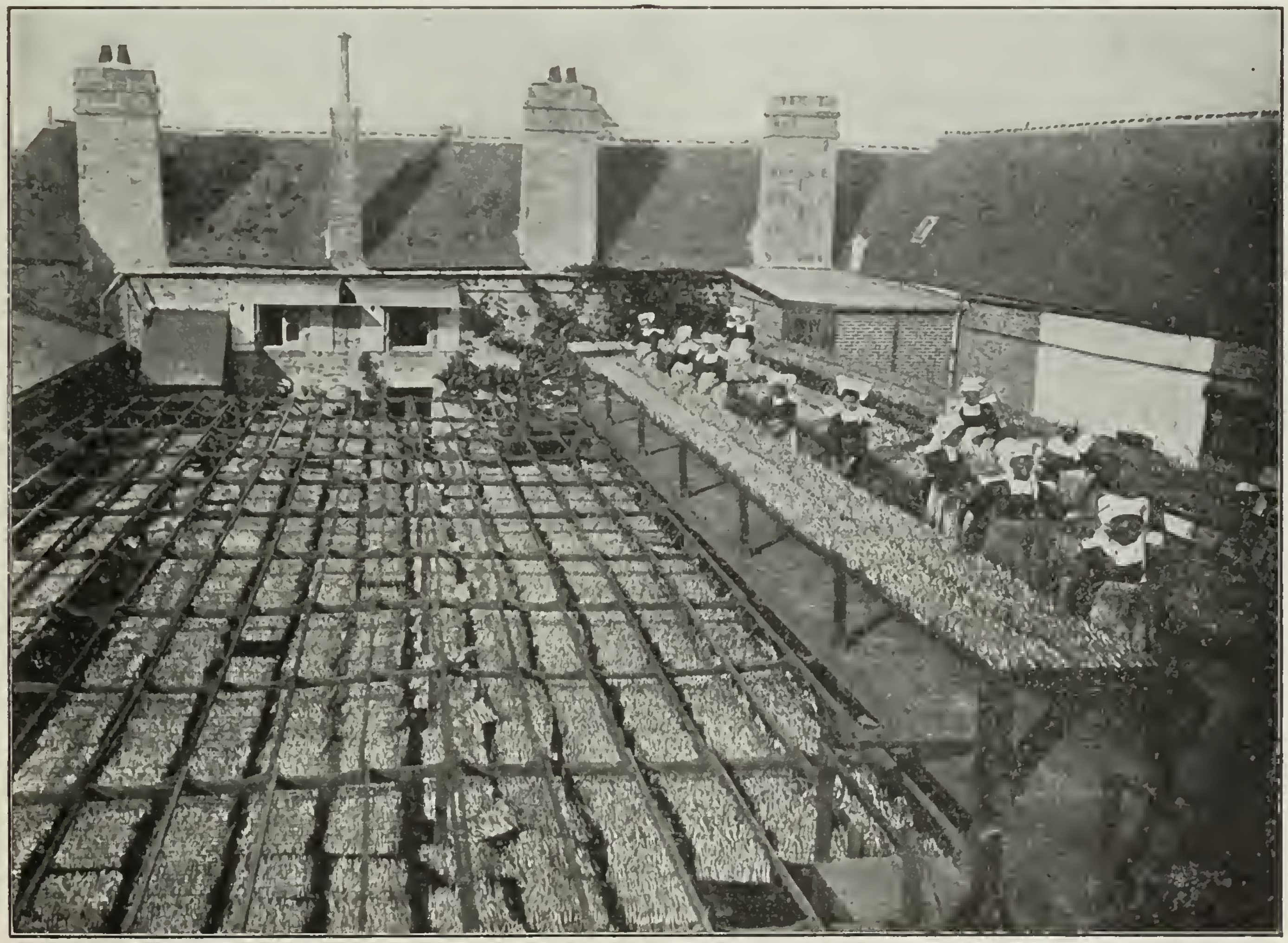
But why on earth—in this case you may be excused for saying "on earth"—cannot the fish help itself to the air around it when it is put on earth? Why should it starve in the midst of plenty, like a rich man who has something the matter inside him? The reason is, that in order to breathe air you must have lungs, or something like lungs, and the fish has none; while in order to get the air which is dissolved in water, which the fish does, you must have something quite different from lungs, which are called gills. The fish has no lungs, but only gills. We have no gills, but only lungs. Therefore, we die in the water and the fish dies out of it. If an animal had both gills and lungs, then it would be able to get air from the air or to get the air which is in water, as it pleased; and it could live both on the land and in the sea.

BRITTANY, THE LAND OF THE SARDINE

BY HUGH M. SMITH

Of the host of American boys and girls who are fond of the well-flavored and wholesome French sardine, probably very few know anything about the country where the sardine is caught and prepared, or realize how many thousands of boys and girls depend on this little fish for their very existence.

The fish is named from the island of Sardinia, in the Mediterranean Sea, about whose shores it abounds. But the word "sardine" has no local meaning now, for it is applied to various kinds of small herring-like fishes in different parts of the world. Maine, Florida, California, Chile, Japan, India, New Zealand, and France have their



THE YARD OF A SARDINE FACTORY, SHOWING SARDINES DRYING ON GRILLS.

own peculiar sardines. The most important and best known sardine, however, is that of France. It is found from Sweden to the Madeira Islands, but is most abundant on the south coast of England (where it is called pilchard), in the Bay of Biscay, and in the Mediterranean. The little fish is especially numerous and important on the shores of the ancient French province of Brittany, and it is of the sardine industry of that country that I wish to give you a few glimpses in this article.

Brittany occupies the northwest corner of France, but will not be found on most modern maps, as it ceased its separate existence as a province more than a century ago. It is a wild and rugged country, inhabited by a hardy people who for many centuries have followed the sea, and to-day are more extensively engaged in fishing than in any other occupation or than any other people of France. The world-wide reputation of the canned French sardine is due to the fine quality of the fish itself and to the care and skill employed in catching and preserving it. While the cod, mackerel, herring, tunny, lobster, oyster, and many other animals are taken, the tiny sardine is the leading product, and contributes more than any other kind of sea food to the fishery wealth of France.

The men who follow the sardine fishery have no other occupation. Most of them are very poor, and, as they usually have large families, they must fish actively in order to make a living; and their wives and daughters are obliged to work in the sardine factories to help support themselves. The boys, when quite young, go out in the fishing-boats with their fathers or elder brothers, and soon learn the ways of the sardines and the methods of fishing; while the girls accompany their mothers into the factories, and, with their nimble fingers and quick wits, readily learn how to cure and pack the little fish. Even when fishing is at its best, the fisherman's lot is unhappy; but when the sardines fail to visit the coast in their usual numbers, as in 1902, the condition of the fishing people is serious, and they sometimes are brought dangerously near to starvation.

The schools of sardines are found on the coast during almost the entire year, but are caught in largest numbers during summer and fall. While the fishing is going on there is a continuous round of activity in the coast towns.

The boats, each with a crew of five or six men, sail early in the morning, often before daybreak, in order to be on the grounds when the fish begin to feed. When the fish are found, the nets are put in the water, the captain of the boat stands in the stern to give directions and to throw the bait, and the men are alert to do whatever may contribute to the success of the day's fishing.

The nets are made of very fine twine, and are stained with a blue dye to preserve them and to render them less conspicuous when in the water. They float in an upright position behind the boat, being supported by corks and weighted with stones.

A BUSY LITTLE BRETON MAID.

When the boats are among the fish, the captain casts bait in such a way as to induce the schools of fish to run into the net in their haste to reach the food. This method of fishing with bait is used to a slight extent in other countries and other fisheries, but is nowhere so extensively carried on as in the sardine fishery of Brittany.

The bait is chiefly the salted eggs of the codfish, and comes in barrels from Norway, Newfoundland, and America. It is a curious fact that the sardine fishery of France should be dependent on the cod fishery of distant lands, and that a scarcity of cod eggs in those countries means a poor sardine catch and a serious time for the fishermen. As the bait is expensive, it is usually diluted or eked out with peanut meal.

When the hungry fish rush against the nets, their heads go through the meshes before they realize that there is an obstruction, and when they attempt to withdraw, the twine has slipped behind their gills and they are caught fast. Nets with fish are not allowed to remain long in the water, but are hauled quickly, and the tiny fish are shaken or picked out and carefully stored to prevent crushing or decay. When the fish have disappeared or the boat is well filled, the sails are set and the men start home, each crew striving to reach port first in order to get the best prices.

After the captain has sold the catch to the highest bidder at so much per thousand fish, the men count their fish into small wicker baskets, carry them ashore, and deliver them to the factories, where they are soon put through the canning processes.

The fish are first beheaded, then soaked in strong brine, and spread on wire grills to drain and dry; they are next cooked in boiling oil, packed in cans of various sizes and shapes, covered with oil, and finally sealed and placed in a retort, where, under great pressure and heat, their cooking is completed and their bones softened.

A BRETON PEASANT'S STONE COTTAGE.

Of the hundred sardine canneries now operated in Brittany, more than fifty are in the two towns of Concarneau and Douanenez; but the real headquarters of the industry are Nantes and Bordeaux, where are the companies which own or lease most of the factories.

A SARDINE FISHERMAN'S HOME.

OFF TO THE FISHING-GROUNDS IN THE EARLY MORNING.

A BUSY SCENE IN THE CANNERY.

Stone is cheaper than lumber for building purposes in Brittany, so that the sardine factories, as well as the dwellings of the fishermen, are nearly always constructed of solid masonry. The canneries are usually large low buildings, surrounded by a wall and often inclosing a courtyard, where the sardines are dried in fair weather. From fifty to three or four hundred persons, mostly women and girls, are employed at good wages in each factory.

A Brittany sardine town in the height of the season is the scene of great activity, and affords the foreign visitor sights of peculiar interest. As soon as the fishing-boats are seen returning,

BACK IN PORT AND DRYING THE NETS.

crowds begin to gather on the quay; and the factories blow whistles or ring bells to summon their women and girls, who are seen hurrying through the streets in their odd, picturesque costume—short dark skirts, glistening white linen caps and collars, and clumsy wooden shoes.

As the boats arrive and begin to discharge their catch, the crowd on the quay is increased by thousands of fishermen in coarse blouses and flat cloth caps, with trousers rolled up and feet bare or in huge wooden shoes. Above the commingled noise of waves and tongues is heard the incessant characteristic rattle of wooden shoes on the stony pavements. As the boats are unloaded, the nets are hauled to the tops of the tall masts to dry; the dock gradually becomes deserted; and the final scene is an intricate mass of boats and masts, with a maze of blue netting and strung corks waving high in the air in graceful festoons.

DAUGHTERS OF A BRETON FISHERMAN.

GLIMPSES OF CHILD LIFE IN JAPAN

BY THEODORE WORES

KUMATARO was the name of a little Japanese boy who lived in Tokio, the capital of Japan, in the house adjoining mine. He was only three years of age, and I met him toddling along the narrow foot-path one morning as I started out for a walk.

"Master Bear," for that is the literal translation of his name, was dressed in a very pretty light-blue kimono, or wrapper, with a bright-red sash, or obi. He wore little straw sandals and short white stockings called *tabi,* which reached to the ankles. These stockings were like mittens: they had a division between the great toe and the others, through which the thong was passed that held the sandal to the foot.

The top of his head was shaved, leaving a circle of hair extending around that made him look like one of those odd Japanese dolls we all have seen.

His little legs were hardly strong enough to hold him up, but, still, he toddled along with an air of dignity that was highly amusing. His dignity did not relax at my approach, and I could not help stopping and making a low bow, in true Japanese style. I remarked most respectfully, "Kekko no tenki de gozaimasu," which is the Japanese way of saying, "What a beautiful day this is!" I feared that my action might scare this little man, for I knew that a meeting with a white man would be regarded by many Japanese children much as suddenly confronting a Turk in a turban would be regarded by a timid American baby.

MASTER KUMATARO EATING WITH CHOP-STICKS.

Japanese children, as a rule, are rather apt to be afraid of foreigners, but this is not to be wondered at, for I found it to be a very general belief that white men carried away little Japanese children if they caught them out alone after dark. I often noticed, as I walked through the streets of Tokio, that crying children suddenly became as quiet as mice on seeing me, and gazed at me with large, frightened eyes. I wondered at this, until one day I overheard a nurse say to a little child, "Be still; here comes a white man, and he will carry you away if you do not behave yourself!"

I was, therefore, rather surprised when, instead of becoming frightened, Kumataro stopped and gravely returned my salutation, ducking his little shaven head in the most approved Japanese fashion, and then resuming his lordly progress. I was, to say the least, somewhat taken aback at the coolness of this little man, especially when I observed that his mother, who stood in the doorway, had not failed to see the humor of it all, and could hardly keep from laughing. After this first meeting I became very friendly with the boy.

Around my house was a pretty Japanese garden which was separated from that of my neighbors by a bamboo fence. Consequently I saw Kumataro almost daily. Japanese houses are very lightly put together. The *shoji,* or doors, which also serve as windows, consist of light lattice frames three feet wide and six feet high. These are covered with thin but tough paper to admit the light, and they slide in grooves along the sides of the room. A narrow veranda usually extends around the house, and is closed at night by wooden shutters that likewise slide in grooves along the edge of the veranda.

The long overhanging roof protects these paper windows and doors from the rain. Glass is rarely used for windows, and it was almost unknown in Japan until that country was thrown open to foreign nations about the middle of the last century. Many of the Japanese, especially the country people, are still so unaccustomed to glass windows that it has been found necessary, in many of the third-class compartments of railway carriages, to paste strips of paper across the windows in order to attract attention to the glass, for it has frequently happened that, in their ignorance, these people have stuck their heads through the window-panes.

There is but little privacy in Japanese houses, for the reason that everything that is said on the other side of the paper doors can be overheard, and as these are usually left open, one cannot help seeing much of the domestic life of one's neighbors.

Thus I often observed little Kumataro at his meals, which, according to the custom of his country, he ate with chop-sticks instead of knife, fork, and spoon. It is very difficult for a stranger to handle these two little sticks, but Kumataro, who had been taught how to hold them properly, managed them so easily that he was able to pick up any little morsel from his plate as easily as an American boy could with a fork.

Everything that is served at a Japanese dinner is cut into small pieces so that it may be picked up and eaten with the chop-sticks. A dinner consists of a number of courses, such as soup made of bean-curd, fish, and mushrooms, or seaweed, which are served in lacquer bowls. This is followed by fish boiled with lotus-roots, and raw fish cut into thin slices and eaten with a sauce called *soyu;* also salad and pickled vegetables and *soba,* and a sort of buckwheat vermicelli. The Japanese eat very little meat, and rice takes the place of bread. Soup is usually served at the end as well as at the beginning of a dinner.

A STREET SCENE, SHOWING DRESS OF JAPANESE BOYS.

Tables and chairs are not used in Japanese houses, and our little friend, in accordance with the general custom in Japan, sat on the floor, with his dinner spread out before him on lacquer trays.

Whenever I called at Kumataro's house I was invited to be seated on the floor. The floor of a Japanese room is covered with fine straw mats, called *tatame,* which are always kept scrupulously clean, for a Japanese never enters a house with his shoes on. These are always left outside of the door, and he walks about on the matting in his stockings. Whenever a Japanese sits on the floor he doubles his legs up under him, crosses his feet, and squats on his heels; and he can remain in this position for hours without becoming tired.

Kumataro had a brother named Matsujiro (literally "Pine-tree"). He was about five years of age, but passed for seven, for the Japanese have a curious method of computing age. No matter when a child is born, its age is always reckoned from the 1st of January. If, for instance, a boy is born in February, the first anniversary of his birth falls on the following 1st of January, and he is then said to be in his second year.

These two little youngsters, like most Japanese children, managed to have a very good time. They had many different ways of amusing themselves, and rarely quarreled with each other. When any disagreement arose they generally settled it pleasantly, as in the following instance.

Master Bear and his brother scrambled, one day, for the possession of a ball that I had thrown over into their garden. The elder boy succeeded in grabbing it, but the younger was by no means disposed to give up his claim to it. Instead of becoming angry and fighting about it, they decided to settle the question of ownership by means of a game known as *ken*. This game is played as follows:

Two players, facing each other, throw out their right hands at the same time. As the hand is thrown forward it assumes one of three positions. An open hand represents a sheet of paper. A closed hand represents a stone. The two first fingers extended, with the others closed, represents a pair of scissors.

The following are the points for the player to bear in mind in scoring the game:

1. Scissors can cut paper.
2. Scissors cannot cut stone.
3. Paper can be wrapped around the stone.

If player No. 1 extends his two fingers and No. 2 his open hand, No. 1 wins, for the reason that scissors cut paper. On the other hand, if No. 2 had presented his fist, he would have been the winner, for scissors cannot cut stone. Again, if No. 1 extends his open hand, and No. 2 his closed hand, the former wins, as the paper can be wrapped around the stone. In case both players make the same movement it does not count, and they try over again. This expedient is resorted to not only by children, but by grown people as well, who often settle trivial disputes in this peaceful manner.

The most popular, as well as the most familiar, of all children's games is known as *hyaku-nin-shu*, or "the poems of a hundred poets." It is a card game, and it is played as follows:

Two hundred cards, each printed with the first or last half of one of these well-known poems, are used.

The cards representing the last half of these short poems are spread out on the floor, while the others are held by the players. Some one who has been appointed reads the beginning of the poem as he draws them from a pack.

The skill lies in quickly uniting the first half that the player holds to the second half on the floor, and the one who first gets rid of all his cards wins the game. It will thus be seen that in order to play this game skilfully it is necessary to be perfectly familiar with these hundred poems, and it is, therefore, as instructive as it is amusing.

Japan fairly swarms with children, and among the most amusing sights, to a stranger, are the numerous small boys and girls that are met with everywhere, carrying babies on their backs. Sometimes these little tots are not much larger than the babies themselves, but they cheerfully assume this burden, for among the lower classes it is considered to be the duty of brothers and sisters to take charge of the next youngest. This does not interfere as much as one would suppose with their childish pastimes, for I have often seen them playing and romping about while the baby, whose head wabbled about in all directions, was sound asleep.

As Kumataro's parents belonged to the wealthier class of Japanese, they employed a nurse, a simple country girl named Otake-san, whose sole duty was to care for and carry Kumataro about. Otake-san, or "Miss Bamboo," gave her entire time and attention to Master Bear, and good-naturedly submitted to his childish whims, and never scolded, though at times he ordered her about in a most lordly manner.

On one occasion she appeared with Matsujiro on her back, and was about to go out on an errand with him, when Kumataro insisted upon going along. As there was no putting him off, Otake-san placed Master Pine-tree on the ground, and after helping Kumataro upon his back, she picked up both boys and carried them off. Master Bear had a doll strapped upon his back, and this gave a most comical three-story appearance to Otake-san's burden.

The Japanese seem to consider the children in almost everything that they do. Wonderful and picturesque processions, known as *matsuri*, are frequent in the large cities, and great two-wheeled carts and floats are most gorgeously decorated and drawn through the streets by oxen. Models of these carts on a smaller scale, and drawn by crowds of happy children, usually form a part of these processions. Toy temples, built especially for children, are often seen alongside of the large ones.

Peddlers of all kinds who trade altogether with children are met with everywhere. One of the special favorites of this class is the *amea*, or candy man. He wanders about through the streets with two boxes slung on a pole which he carries on his shoulders. Every once in a while he puts down his burden and blows a tin horn, whereupon the children of that neighborhood come trooping up to him from all directions.

Kumataro and his brother rarely failed to get a few copper coins, worth about one tenth of a cent apiece, wherewith to buy candy.

The stock in trade of this popular tradesman usually consists of a quantity of soft molasses candy. A lump of this is fastened to the end of a thin bamboo tube, and then he proceeds to blow into it very much after the manner of a glass-blower, forming, at the same time, with his fingers, very clever representations of animals, masks, birds, fruits, and flowers—in fact, anything that his little patrons chance to order. I have often amused myself, at an outlay of ten cents, by treating a crowd of ten or twenty children that had gathered around one of these candy men. Nothing could be funnier than the critical attitude that these little men sometimes assumed, for they were always ready to point out faults in these works of art, and to insist on having them corrected before paying for the wares.

Another favorite of the children is the pancake man. Like the candy man, he carries two boxes, the tops of which are covered with sheets of polished copper, underneath which are braziers filled with burning charcoal. The children gather about him, and for a small copper coin each one buys a cupful of soft dough.

They then proceed to make pancakes by pouring out a little of the dough on to the hot copper plates. The pancakes are made about as large as a silver dollar, and the process is continued until the supply of dough is exhausted.

Two holidays especially for children are observed by the Japanese during the year. One occurs on May 5, and is called "Boys' Day," and the other, on March 3, is known as "Girls' Day," or the "Feast of Dolls." On Boys' Day the streets present a very bright and festive appearance, as almost every house is decorated with a tall bamboo pole to which one or more large paper fish are attached. The number of fish hung from each pole corresponds to the number of boys in the family.

These fish are very cleverly constructed, and are painted so as to present a very natural appearance. They are fastened to the pole by a cord passed through the jaws, and openings at the mouth and tail allow the wind to blow through, filling them out and causing them to plunge about in a most lifelike manner. These paper fish vary in length from three to twenty feet.

In many houses, on this occasion, miniature stands of arms, containing swords, spears, bows, banners, and suits of armor, are brought out of the *kura,* or storehouse, and placed on view. Some of these toy weapons are as carefully made as the real things, and are often very old, having served on Boys' Day in the same family for many generations. On Girls' Day almost every household has more or less of a collection of dolls on view. These dolls are carefully packed away, each in its own wooden case, during the year, and are only brought out on these special occasions, when it is the custom for little girls to pay visits to one another, exchange the compliments of the season, and admire one another's dolls. In addition to these dolls, all sorts of miniature household articles, consisting of dressing-cases, toilet-sets, furniture, and kitchen utensils, etc., made of silver and lacquer, are displayed. The principal dolls imitate the mikado and his empress in ancient court dress. Many of these collections of dolls are centuries old and are highly valued by their owners.

Theodore Wores.

MISS BAMBOO CARRIES MASTER BEAR AND MASTER PINE-TREE.

It will thus be seen that Japan has not without reason been called a "children's paradise." While my own observations have proved to me that Japanese children are about the happiest I know, I have also observed that they always display the greatest respect for their parents and elders, who are thus more than repaid for the unfailing love and attention they bestow upon the little ones of the "Sunrise Kingdom."

THE ZIGZAG ROAD UP THE PASS TO THE HOSPICE OF ST. BERNARD.

THE DOGS OF ST. BERNARD

BY W. G. FITZ-GERALD

Come with me in the alpine diligence for a drive up the queer zigzag road that goes twisting and climbing until it pierces the wet and misty clouds and reaches a region of eternal ice and snow. Here, in a climate almost as cold as Greenland, we shall find a band of men who do a great and good work, assisted by dogs, as Bernard de Menthon did long years ago.

We start from the lovely village of Chamonix at the very foot of mighty Mont Blanc and drive to Martigny. This "diligence" is the road-coach of the Alps, drawn by five big horses all decked with bells and fly-flickers. The air is like wine for its bracing sweetness, and all around us are roaring cataracts, glistening glaciers, or moving ice-seas; gloomy ravines and towering peaks, below whose topmost crags thin wisps of cloud float like wreaths of gauze.

Round and round, up and up. It grows colder as we ascend, and the smiling landscape fades away. The pretty flowers disappear too,—the anemone and gentian; dark-leaved saxifrage and sweet alpenrose. We shiver, even in August, and put on our wraps and furs.

We have passed from summer to winter in a few hours. Now we enter the Valley of Death, so called from its many fatal memories. Here at the most dangerous part of the St. Bernard Pass a little shelter-house has been built; and parties climbing still higher to the famous hospice or monastery can now telephone their coming. This has saved hundreds of lives. For nowadays, after such a message, the good monks at the top look out for the travelers, and if they fail to appear after a certain time search-parties of dogs are sent out to look for them. Here is deep snow even in August. It is so bitterly cold that we get off and walk to warm our numbed limbs; and soon the bare, bleak walls of the world's loftiest house of charity loom through the damp mist. Winter lingers here for ten long months; and the few weeks of "summer" do not suffice to melt the wilderness of ice and snow. We are here nearly nine thousand feet above the level of the sea, and the slightest exertion distresses our breathing apparatus, so rarefied is the air. No sooner are we at the door than a dozen monstrous dogs come baying forth to greet us. No questions are asked. It is understood we require dinner, a warm and comfortable bed, breakfast next morning, and full directions and protection for our onward journey.

In the reception-room is a big piano which King Edward, then Prince of Wales, gave the monastery nearly fifty years ago. The Emperor Frederick of Germany and his Consort also passed the night here, as also have a host of world-famous celebrities. For nearly ten centuries, from generation to generation, some fourteen monks and eight or nine attendants have occupied the monastery and helped travelers crossing over the summit of the Great St. Bernard.

It is sad to think that even these helpers have to descend periodically in search of health, so terribly trying is the climate. The dogs themselves, even, suffer severely from rheumatism.

At present the monastery costs about $9000 a year to keep up, and this money is partly collected in Switzerland and partly derived from the revenue of the monastic order. But in the Middle Ages the monastery was stripped of all its wealth, though it still continued and continues to this day to carry out the work of St. Bernard. Over thirty thousand travelers pass this way every year, and hundreds of these, at least, would lose their lives were it not for the guardians of the mountain.

PLAYING WITH THE DOGS IN THE COURTYARD OF THE HOSPICE.

THE ALMONER OF THE HOSPICE AND SOME OF THE VETERAN DOGS. CÆSAR, THE DOG IN THE FOREGROUND, HAS SAVED MORE THAN TWENTY LIVES.

The poor emigrant laborers from Switzerland are often found by these faithful dogs, in the snow, utterly exhausted from hunger and fatigue, and often with badly frozen limbs. These are tenderly nursed in the spotlessly clean infirmary of the hospice. I visited this lofty house of charity in the clouds. Of course the great attraction is the kennels of the famous St. Bernard dogs. One is grieved to learn that even these, hardy and intelligent as they are, often perish in terrible storms. They are big, powerful, short-haired animals, most of them,—white, but with a few brown patches. Last winter five magnificent creatures were lost in a furious blizzard. I saw one or two aged veterans over twenty years old; these are now privileged to lie before the kitchen fire, and each of them has saved over twenty lives in the snowy wastes. The monks are not now so dependent on the dogs for news of travelers in distress, because of the telephone I have already mentioned. The scent of these dogs is so wonderfully keen they can track a man's footsteps in the snow two or three days after he has passed. It is a grand sight to see the monks and their attendants go forth in their big fur coats, high rubber boots, helmets, and swan's-down gloves.

Behind them come assistants with long ash poles, ice-axes, alpenstocks, spades, wine, and provisions.

FORTIS, ONE OF THE ST. BERNARD DOGS. HE HAS ALREADY SAVED SEVEN LIVES.

When the first heavy snows come in September the paths are marked with posts twenty feet high. But these soon disappear and other posts are fixed on top of them, and so on. Soon the winter paths lead indifferently over enormous rocks and buried alpine huts. The greatest danger comes from the furious gales shifting the snow and making return impossible. The rescue parties are always led by the dogs, whose intelligence is never questioned. Sometimes the dogs go prospecting on their own account, and each carries a supply of good red wine in a flask about his neck. Should he track and find some wayfarer in the snow, or fallen down a precipice, he gallops back to the hospice with a message that is unmistakable. Then the rescue party goes out, rubs the frozen limbs of the unfortunate with handfuls of snow, and encourages him to rise and walk a little. If this be impossible, or the victim be dead, he is borne back on the stalwart shoulders of the monks' attendants.

I was most interested to learn that the pure race of St. Bernard dogs cannot live away from the mountain they have been associated with for so many centuries. In the plains they degenerate in size and strength, and their wonderful sagacity grows duller. Under no circumstances will the hospice sell or part with their dogs, although they have had many tempting offers from foreign travelers, who will pay a high price.

Most notable among these four-legged saviors is Oliver, with a record of fifty-six rescues. He is to be sent to Martigny, where the monastery has a kind of sanatorium in which the dogs try to regain the health and strength they have lost in the service of strangers.

THE HOSPICE OF ST. BERNARD.

OUR NEIGHBOR JOHN.

BY HARRIE PRICE.

Albertine Randall Wheelan.

He studies from dawn to dark.....

Flies Kites when a man....

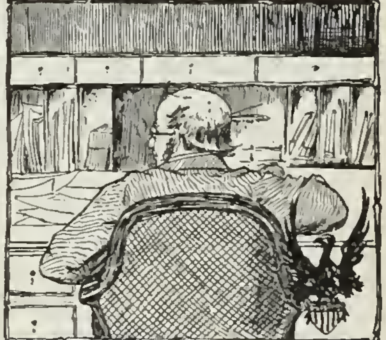
He sits with his back to the Teacher...

...cordially shakes his own hand

WE cannot ignore him, for he is our nearest neighbor in his direction—under our feet. Perhaps the fact that he is opposite to us in location may prepare you to learn that he is opposite to us in many other respects.

He studies from dawn till dark while a boy, and walks on stilts, plays ball and marbles, and flies kites when he is a man. He is fond of fireworks, but displays them principally by daylight. He rides in boats drawn by men, and in a vehicle (which might be called a carriage or a wheelbarrow, according to one's mood) moved by sails. The needle of his compass —the mariner's compass being his own invention, by the way—points to the south; and he talks of the "west-north" or the "east-south," as the case may be. His own name is likewise turned about. If he is John Chinaman with us, he would be Chinaman John at home. In school he sits with his back to the teacher and studies his lesson aloud. The ferule reaches for him if he fails to study loud enough. He dates his letters with the year first, and begins to read on the lower right-hand corner of the last page. If John is mortally offended

NOTE: Life in China is undergoing vast and wonderful changes, and our "celestial" brothers may soon seem like ourselves. This article merely presents John Chinaman in his queer, old-fashioned guise.
EDS.



or insulted, he does not attack his enemy as a hot-headed American might do; but kills himself instead on the enemy's door-step, and the mourning relatives don white to show their grief.

When John wishes to pay special respect to any one, he keeps his hat on and takes his shoes off in that one's presence. When he meets a friend he grasps and cordially shakes his own hand, leaving the friend to do the same for himself, instead of heartily performing that operation for each other, as we do. If so glad to see each other that hand-shaking does not express their joy, they rub shoulders until tired out. John shaves, not his face, but his head and eyebrows; he whitens his shoes; he wears a long gown, and carries a fan. He assumes the duties of milliner, laundress, and dressmaker; he pays the doctor as long as he is well, but stops payment as soon as he is ill.

When John is of marriageable age he must be satisfied with a bride whom he has not previously known; and the courtship is not expected to last more than three days. In this way he runs little risk of seeing himself cut out by a rival, and also avoids losing much time. In the Lalos tribe of western China, the bride perches herself on the highest attainable branch of a large tree when the wedding morning arrives, while the mother, grandmother, aunts, and elderly female cousins, all armed with sticks, cluster on the lower limbs. It is only when John has earned her by successfully breaking through this "picket-line" and carrying her off, that he is allowed to have his bride.

As a father, John idolizes his boys, but feels keenly the disgrace brought by the advent of a daughter. He does not consider her worthy of a name, but calls her Number 1, 2, or 3, as the case may be. He ignores her entirely in telling the number of his children, counting only the boys. He considers her as without mind or soul, and denies her the advantages of education which her brother receives. As she grows up she is a slave in her own and her husband's house; and not till she is old does she receive love and reverence.

If a child is taken sick, both John and his wife think the soul has wandered away, and steps are taken to recall it. The mother calls at the open door, "Soul, come home!" The father goes out to seek it, usually searching about the nearest bridge. At his cry of "Coming, coming!" the mother looks carefully about her floor and secures the first thing of life she sees. This may be flea, or beetle, or other insect, but is supposed to have within it the missing spirit. It is wrapped up and joyfully placed under the pillow of the sick one, who is now expected to recover forthwith. If death comes instead, the child is buried summarily and with scant ceremony. John considers his own coffin one of the most valued and most necessary pieces of furniture for his best room, and his highest ambition is to have an elaborate funeral. He and the older members of his household have this ambition gratified in proportion to their wealth and the number of their descendants.

As an inventor John has achieved some distinction, and has won for himself the name of the "Yankee of the East." Besides the mariner's compass, type, printing, paper, porcelain, silk, gunpowder, and clocks are some of his alleged discoveries. He has kept the knowledge of these things to himself as much as possible, scorning to give to those so much inferior to him as he supposes other nations to be, the knowledge which he has made his own. John himself and his countrymen are "celestials," his Emperor is the "Son of Heaven"; why should he stoop to benefit a people so much beneath him as the inhabitants of England or the United States! John's school-books give amusing testimony to the abundance of this national pride and self-satisfaction. His geography allots nine-tenths of the globe to China, about a square inch to England, and no space at all to our own great country! This same self-conceit helps to account for the lack of progress noticeable in John and his countrymen. For centuries they held themselves quite apart from other nations.

At the same time, John's nation is, in its way, an educated nation. All public offices are open to the graduates of their colleges, without any distinction of class or creed. Brains and skill, rather than money, are the highways to honor and office.

John's language is said to be the hardest of all to learn. His alphabet has two hundred and fourteen letters, and such complications of tones and inflections that one word spoken in ten different ways means ten different things.

As a business man John is not remarkable for honesty, to say the least. One traveler asserts that the first Chinaman by whom he was swindled was the first one with whom he had any business transactions—and that the last one who swindled him was the last native with whom he had any dealings when he left the country a year later.

John, as a soldier, is so brave that he goes to a night attack with his lighted lantern. It may expose his whereabouts to the enemy, to be sure, but if hostile soldiers are to be dreaded, much more the dark—in John's opinion.

John's religion? He has plenty—such as it is. Every trade has its patron divinity. The joss-houses have their idols by the dozen, and John smokes and chats as he prays. As he has only a single tongue, however, he must use some device to do either the chatting or the praying. So he prays by means of two sticks, half round, determining by the way they fall whether or not his prayer is granted. Or he prints his prayer on a strip of red paper and pins it on the wall near the door. At the proper time the priest sends it, with other accumulated prayers—petitions expressing many strange desires—up into the air on the wings of fire.

ROBINSON CRUSOE'S ISLAND

(*Two Hundred Years Later*)

BY FRANCIS ARNOLD COLLINS

WHAT boy would not feel perfectly at home on Robinson Crusoe's island? The cave hollowed in the rock, the garden where he grew his wheat and tended his goats, the forests and plains of Crusoe's island-domain, have been the playgrounds in imagination of boys for generations. We have all wandered with Crusoe over the familiar paths, explored the cave, or sat upon the lookout watching, with a delightful sense of disappointment, for a sail.

And the island of Juan Fernandez, where the real Robinson Crusoe lived so long alone, looks exactly as we would expect it to appear. Some time ago the island was visited by a Chilean war-ship, and a party of her officers—remembering Crusoe with affection, as people do the world over—carefully explored Crusoe's kingdom and took a number of photographs. When these photographs were looked upon for the first time by people in the United States and Europe, they seemed, somehow, strangely familiar. They served to bring old playgrounds of the imagination suddenly to life.

It is now two centuries since the actual Crusoe landed upon this solitary island. His name, it will be remembered, was Alexander Selkirk, though, strangely enough, he, too, like Defoe, spelled his name differently from the form used by his father before him, for Selkirk's father spelled his name Selcraig. Of all the labors of the immortal Crusoe, time has left few traces. Selkirk lived much the same life which Daniel Defoe describes in the story. The cave hollowed from the rock, with the rude remains of its stone supports, may still be recognized. The lookout,—the conical hill, "very steep and high,"—where Crusoe watched so many weary hours, rises near by. A large bronze tablet commemorating Selkirk's sojourn on the island was placed near the base of the lookout by the officers of an English war-ship in 1868. Crusoe's garden is buried beneath two hundred years of tropical vegetation. The long flat beach where he landed, however, is readily identified.

So closely has Defoe followed the actual story of Selkirk's adventures that "Robinson Crusoe" might even now serve as a guide-book for his island. The scenes as Defoe describes them, often with surprisingly few words, have, in two centuries, lost nothing of their charm. The photographs of these scenes do not in any sense contradict the narrative. With the actual photographs of the lookout before one, where Crusoe—or rather Selkirk—first climbed to look about him, Defoe's description borrows a new meaning. "There was a hill not above a mile from me," says Crusoe, "which rose up very steep and high. . . . I traveled for discovery up to the top of that hill, where, after I had, with great labor and difficulty, got to the top, I saw my fate, to my great affliction, viz., that I was in an island environed every way with the sea." Let one study the photograph of the cave, and Defoe, it will be found, has not used a word amiss. "I found a little plain on the side of a rising hill, whose front toward this little plain was steep as a house side. . . . On the side of the rock there was a hollow place, worn a little way in, like the entrance or door of a cave, but there was not really any cave or way into the rock at all."

The adventures of Selkirk differ only in detail from the story of Crusoe. The real Crusoe, as we may call him, was not shipwrecked, but came ashore voluntarily. He was a Scotchman, and landed from an English ship, the "Cinque Ports," a little vessel of but ninety-odd tons burden, carrying eighteen guns, commanded by Captain William Dampier, in 1704. Selkirk was the sailing-master of the vessel, and, in reality, he had had a "falling out" with the captain some time before, and had begged to be put ashore. Just what this quarrel may have been is not known, since the account comes from the captain himself. Selkirk lived alone on the island for four years and four months, and was then rescued by Captain Rogers, of the "Duke," and taken back to England. Captain Rogers wrote the original account of Selkirk's adventures, so that we have the true story of this famous romance at first hand.

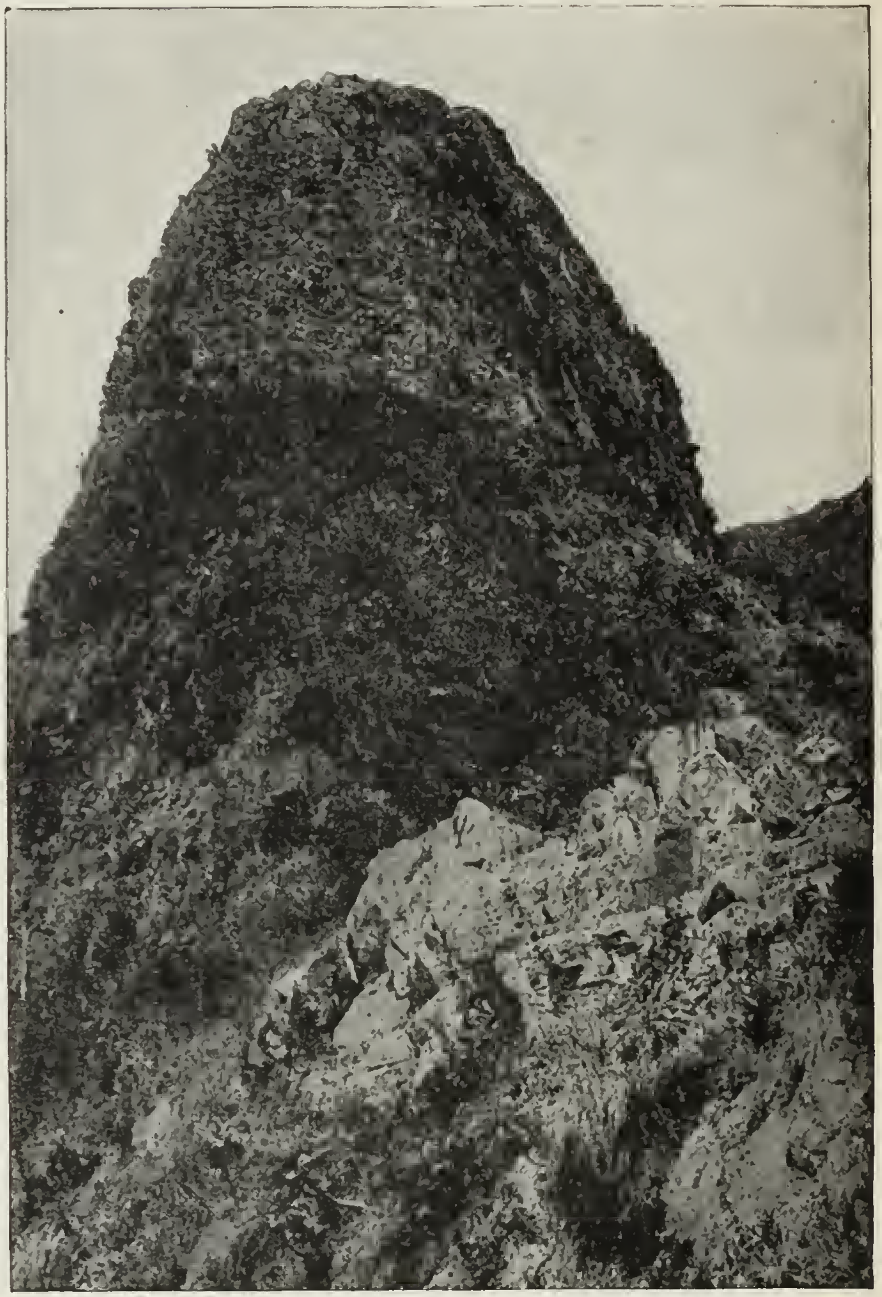
When Selkirk landed to take possession of his island-kingdom, he carried fewer provisions than did the Crusoe of the story. A boat from the "Cinque Ports" brought him to the beach with his seaman's chest and meager possessions and put him ashore.

As the boat pulled away, Selkirk quickly regretted his act, and begged on his knees to be taken back to the ship. The sailors refused, returning alone, so that the original Crusoe found himself an unwilling prisoner. There was little romance in the situation. His entire possessions comprised only some clothes and bedding, a firelock, one pound of powder, some bullets, tobacco, a hatchet, a knife, a Bible, and his mathematical instruments and books.

Four years and four months later, when Selkirk—now safely on board the "Duke"—told the story of his adventures, the misery of those first hours on the island was still clear in his memory. As the ship disappeared, he sat upon his seaman's chest in utter dejection. He ate nothing for many hours. His greatest fear was that with the coming of night he would be attacked by wild animals. In his own words, "I went to sleep when I could watch no longer." For a long time he remained in such low spirits that he could eat only at rare intervals. His first food was the flesh of seals and the coarse food picked up along the beach.

For several weeks Selkirk continued to eat raw food. He carried flint with him, but could find no tinder to start a fire. He would not use his shirt, since he preferred to go without cooked food to going undressed. The famous suit of goatskins was not thought of until later. The cooking problem was finally solved by rubbing two sticks together, Indian fashion, to start a fire. The flesh of young goats remained his principal food to the end. His favorite method of cooking was to impale a large piece of the meat on a splint of palmetto wood and broil it by turning it slowly before the fire.

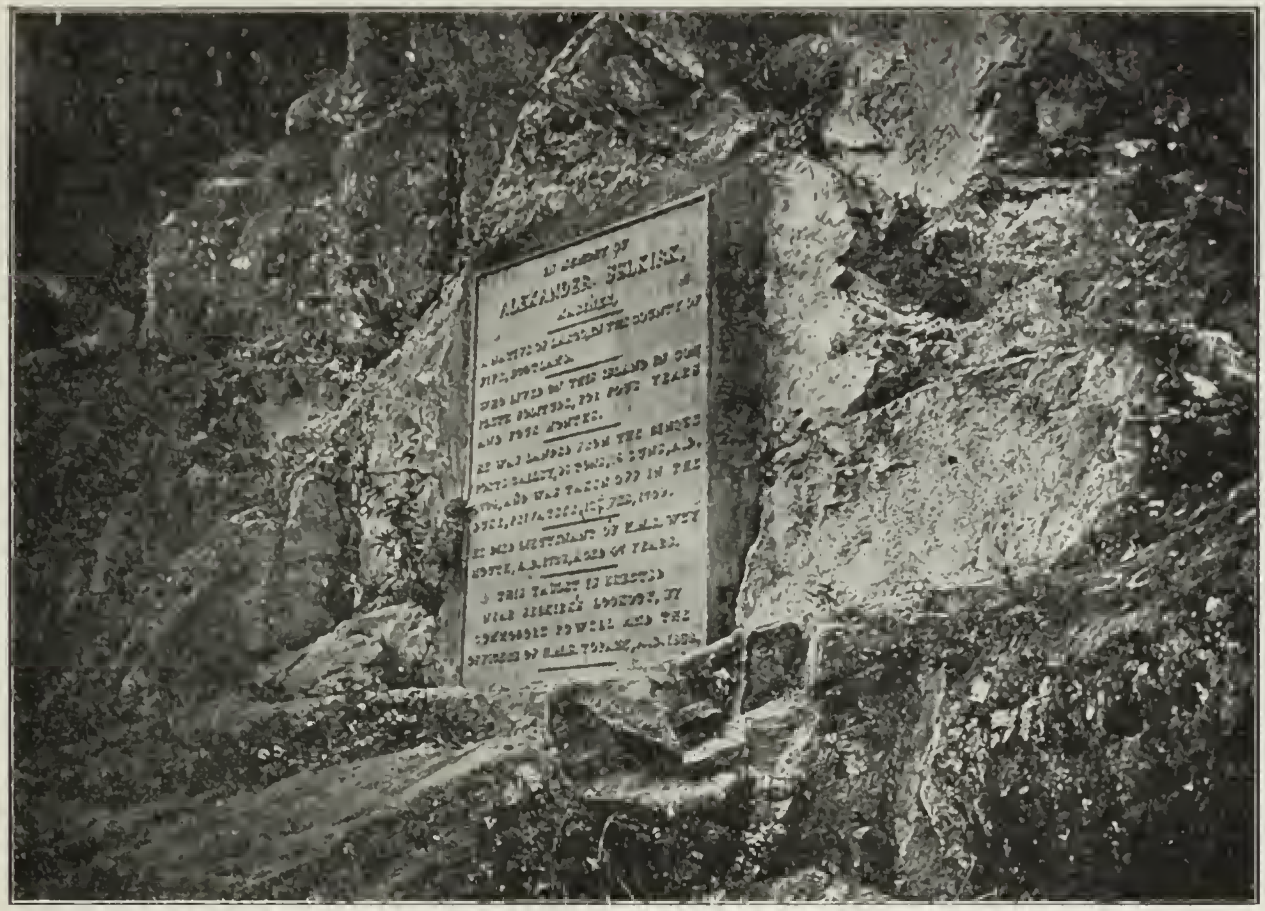
The island was well supplied with wild goats, as it is to this day. Nevertheless there were times when poor Crusoe—or rather Selkirk—had great trouble to secure a meal. He shot the goats at first, but his supply of powder soon failed him. After that there was nothing to do but to catch the goats on foot, and many a chase the nimble little creatures led him. In time, however, Selkirk learned to run so swiftly and to dodge and leap so quickly that he had no trouble in winning these curious races. Selkirk killed in all more than five hundred goats; and, not content with supplying his present needs, he caught many young goats and tamed them, that he might be sure of his food when he grew too old to run.



CRUSOE'S LOOKOUT. IN THE CLIFF AT THE RIGHT CENTER OF THE PICTURE WILL BE SEEN THE TABLET ERECTED TO SELKIRK'S MEMORY.

"There was a hill not above a mile from me, which rose up very steep and high. . . . I traveled for discovery up to the top of that hill, where, after I had, with great labor and difficulty, got to the top, I saw my fate, to my great affliction, viz., that I was in an island environed every way with the sea."—Robinson Crusoe.

Toward the end of Selkirk's first year on his island he commenced to write his famous diary. In reproducing this incident later, Defoe, for all his genius, could improve but little upon the interest of this original manuscript. Selkirk began the story of his life by telling of his terror of the sea, his dread of wild animals, and his fright at the barking of the seals. He was finally compelled by hunger to look about him. He found abundance of raw meat and cabbages and herbs. Eight months after his landing on the island he wrote that he was at last entirely reconciled to his lot. His life in the years that followed has been the envy of many men and boys in many countries. There was little cold or rainy weather, so that he was constantly out of his cave. By day he worked in his garden or explored his island-kingdom. On clear evenings he amused himself for hours at a time by lying on his back and counting the stars.



TABLET ERECTED NEAR SELKIRK'S LOOKOUT ON THE ISLAND OF JUAN FERNANDEZ, BEARING THE FOLLOWING INSCRIPTION:

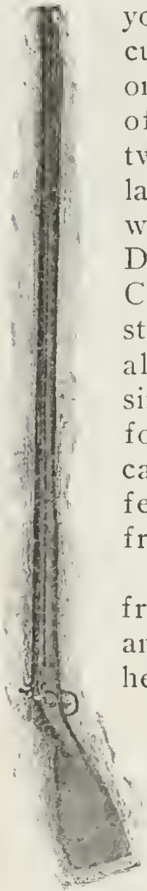
> In memory of ALEXANDER SELKIRK, mariner, a native of Largo, in the county of Fife, Scotland, who lived on this island in complete solitude for four years and four months. He was landed from the "Cinque Ports" galley, 96 tons, 18 guns, A.D. 1704, and was taken off in the "Duke," privateer, 12th Feb., 1709. He died Lieutenant of H. M. S. "Weymouth," A.D. 1723, aged 47 years. This tablet is erected near Selkirk's lookout, by Commodore Powell and the officers of H. M. S. "Topaze," A.D. 1868.

Selkirk soon tired of the famous cave which he had so laboriously hollowed in the rock. An earthquake had loosened a part of the roof, and he feared further accidents. He had attempted to give the rock support meanwhile by building a crude pillar of stones, part of which still stands. Toward the end of his first year of exile Selkirk set about building a house. He finally completed two little huts, using one for a bedroom, and the second and smaller one for a kitchen. The little cottages were built with the wood of the palmetto, which he had laboriously hewn from the forest. The walls and roof were formed of long grass, which was from time to time renewed. The furniture of the two rooms was also, in a very literal sense, home-made. The few chairs and the table were made of palmetto and upholstered with goat-skins. The bedstead was Selkirk's especial pride.

For all Selkirk's terror of wild animals, nothing ever visited him more ferocious than the rats. He complains of them bitterly in his journal, however, telling of their inroads on his larder, and of how, growing more ferocious, they even bit his feet as he lay asleep. But Selkirk proved equal to this new call upon his ingenuity. The story of Robinson Crusoe tells the exact truth about it. Selkirk made a business of raising cats, feeding them with goat's milk. Thereafter he slept with hundreds of his cats lying about him, and as a reward of his ingenuity slept soundly.

Meanwhile most of Selkirk's scanty store of shirts had worn threadbare. Once more his ingenuity, which had served him so well throughout his stay in the island, came to his rescue. On looking about him for material, he hit upon the idea of his famous suit of goat-skins. In the story of Crusoe, it will be remembered, Defoe carefully reproduces this incident. Selkirk skilfully dried the skins and made for himself a complete suit, consisting of trousers, jacket, and cap. For this extraordinary piece of tailoring Selkirk used a nail for a needle, stitching with thongs of the skin. Later, finding a piece of iron hoop on the beach, he made several new blades for his knife. In the attempt to make shoes, however, his skill failed him, and this despite the fact that Selkirk had once been a shoemaker. All the shoes that he had made fell apart, and in the end he was forced to go barefooted.

Life was not all work, however, even for the industrious Crusoe. He spent many hours, for instance, his journal attests, in taming young kids. Another amusement was to cut his name, with the date of landing, on innumerable trees in different parts of the island. The tropical growth of two centuries has left no trace of these labors visible on the island to-day. It was from this incident, doubtless, that Defoe conceived the idea of having Crusoe keep a calendar with notched sticks. Throughout his stay Selkirk was also in the habit of praying, reading, and singing in a loud voice each day, often for an hour at a time. He explained candidly in his journal that he did so for fear he might lose the power of his voice from disuse.


SELKIRK'S GUN.

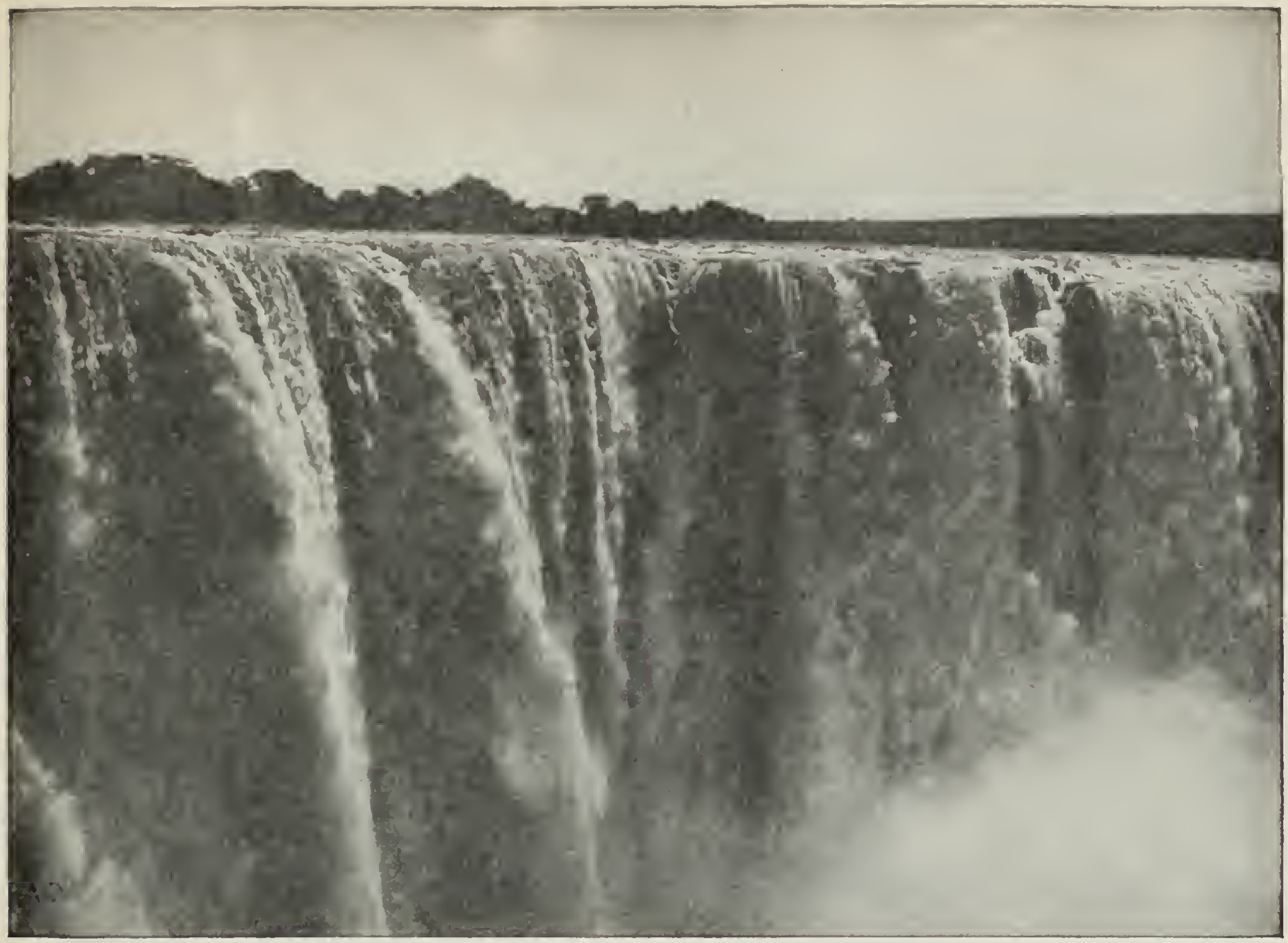
It was only after Selkirk had watched from his familiar lookout, in fair weather and foul, for more than four years that he was finally rewarded by the sight of his old ship. When Captain Dampier landed upon the beach, Selkirk was already standing on the edge of the forest, waving a white flag. In honor of the visit, he wore his last shirt, which he had carefully kept for years for this occasion. The captain afterward noted in his account that Selkirk spoke in a voice which, for all his pains, sounded scarcely human. His feet had been hardened like leather from long exposure. For many weeks he refused to touch any liquor, nor had he any appetite for civilized foods. Selkirk greeted his old shipmates with a delight that may be imagined, and before leaving his island he entertained the ship's crew in his "house."

SELKIRK'S CHEST AND CUP.

The island was visited but once by any ship during Selkirk's long exile. A Spanish ship once landed on the island a small company who caught a fleeting glimpse of Selkirk. In those days the Spaniards were the deadly enemies of the English, and doubtless Selkirk had recognized the ship's colors from his lookout, and drawn his own conclusions. In the story of Crusoe, it will be remembered, Defoe makes much of this visit of the Spaniards, and has them prostrate themselves before Crusoe as the "governor of the island." As a matter of fact, however, Crusoe (or Selkirk) played a much less dignified part than Defoe would have us believe. The Spaniards shot at and chased him for some distance without success.

The solitude and many hardships of this lonely life would doubtless have driven most men crazy. Selkirk, however, kept his wits through it all, and when he finally returned to Scotland, after an absence of eight years, was able to take up his old life where he had dropped it, and, despite his barbarous life, was still a civilized man.

In writing "Robinson Crusoe," Defoe, with a story-teller's license, took many liberties with the original narrative. One of these changes has been to tell us that Crusoe's island was situated on the east coast of South America, near the mouth of the Orinoco River. There can be no doubt, however, that the island of Juan Fernandez, with its cave and its lookout, was the island which Defoe has described; nor that the adventures of Alexander Selkirk have been faithfully reproduced, with an added charm, in the story of "Robinson Crusoe."



VICTORIA FALLS, ZAMBESI RIVER.—MAIN FALLS FROM RAIN FOREST.

IN RAINBOW-LAND

BY AMY SUTHERLAND

UNTIL only a few years ago, the Greatest Wonder of the World lay hidden away in one of the most savage parts of Africa. The natives of that region, terrified by its mysterious columns of vapor and its subterranean thunder, did not venture within many miles of it. The white men who had looked upon it could be counted on the fingers of one hand.

And yet, more than fifty years have passed since the explorer Livingstone, journeying eastward along the Zambesi, first beheld that rainbow mist rise above the forest. Of its cause he could learn nothing from the savages; and so, except for his own conjectures, he came quite unprepared upon his splendid discovery. He approached it by the river, which above the Falls is a mile wide, and below them runs for fifty miles at the bottom of a gorge between four and five hundred feet deep, whose twin walls of black, precipitous rock show for all that distance scarcely a ledge or slope where the smallest plant may cling. So, after a peep downward at the Falls, from the island on their brink which now bears his name, he left his new-found marvel less than half seen, and departed whence he came.

And the loneliness of those vast solitudes brooded once more over forest and river, to be broken only at rare intervals by some wandering hunter, or perhaps by a party of men adventuring through endless toil and danger to behold a wonder whose fame, even then, spread as far as that tiny portion of South Africa where white men dwelt and civilization held sway. So things remained until the day of Cecil Rhodes, under whose auspices went forth the *voortrekkers,* or pioneers, to colonize the vast land now called Rhodesia, in the heart of which the Victoria

Falls lie. Many of these voortrekkers, and their wives and children, died at the hands of the savage Amatabele tribe of natives; but the survivors in the end were victorious, and the country became their own.

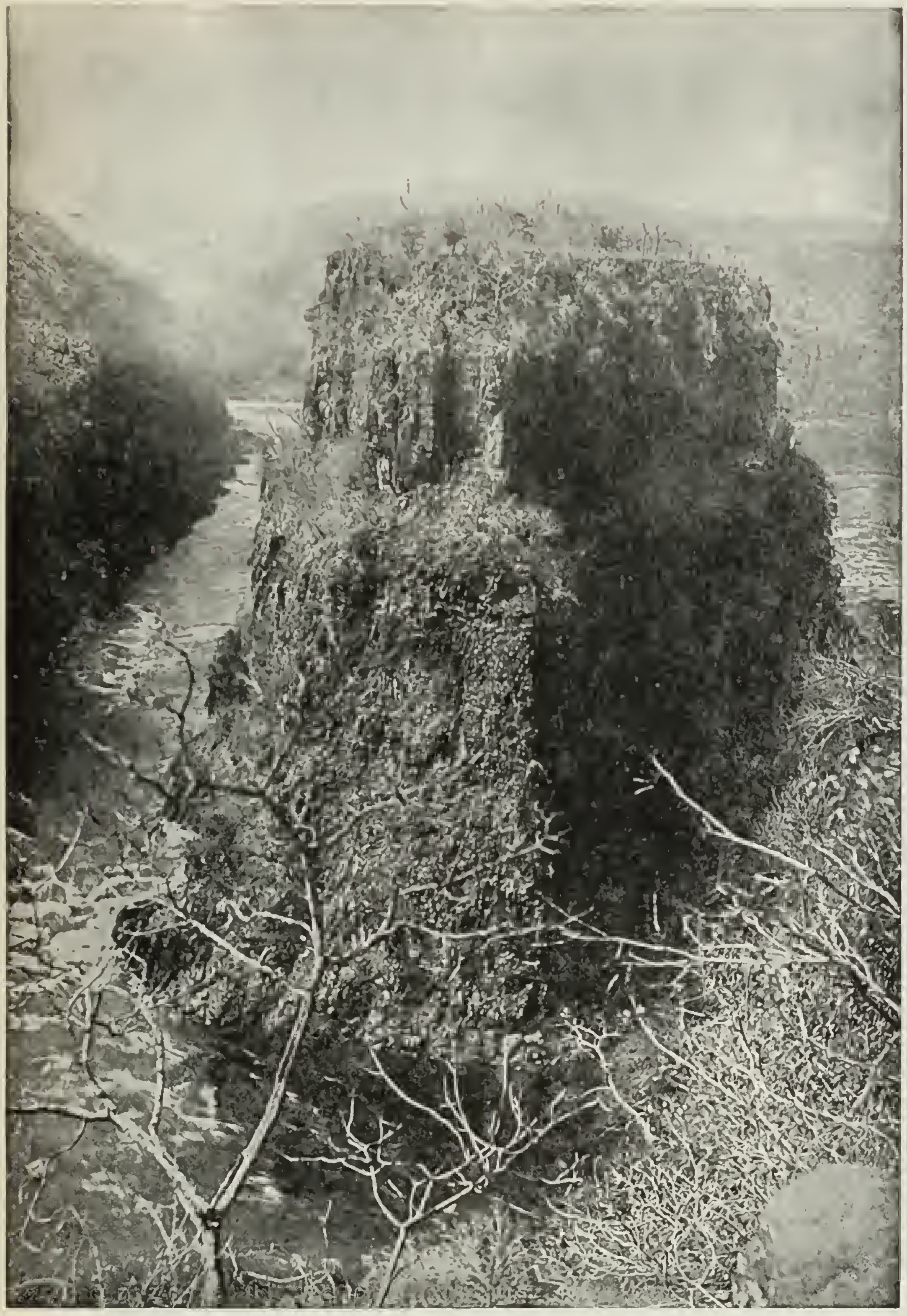
Cecil Rhodes died, and was laid in his lonely grave among the Matopo Hills, on a rocky summit which looks far out over the land he loved. But his wishes were remembered, the greatest and the least of them; and still, year by year, the Central African Railway grows, every year a little, northward through the forests. And now it has reached the Zambesi, and over that hitherto unconquerable gorge has been thrown one of the most wonderful railway bridges ever built; and close by has sprung up a great hotel, so that the Victoria Falls and their surroundings are attainable at last by all the world.

For many days the approaching traveler has been flying through a mighty tropical forest, in which a path has been cut for the railway line, but which is otherwise so undisturbed, so vast and silent and lonely, that it is hard to believe white men can ever make a home in it. Here the lion prowls at his own sweet will, and legions of antelopes, great and small, graze on the sweet veldt. And here elephants wander in troops of fifty or more, and in the swamps the hippopotamus plows his way through the papyrus reed and the ten-foot Rhodesian grass. The little iron shanties of the railway men are the only signs of civilized life. The natives of the country are few and far between; their kraals, with the conical huts peculiar to this race of Africans, look down from the rare, slight eminences.

There is no change in the scenery, little to give warning of the wonder that one approaches. Only, above the noise of the train, a far-off murmur of sound grows upon the ear; and a little while later, floating upward from out the forest, there comes in sight a long line of snowy vapor, which, as the low sun touches it, glows with soft, many-colored lights. This mist-cloud is caused by the sudden narrowing of the great Zambesi River in the Chasm, not two hundred yards wide, which receives the Falls at the end of their leap. The cloud rises at times as much as five hundred feet into the air, and there condenses into rain, which falls in eternal showers glorious in this thirsty land, and makes in the country close about the Falls one perpetual spring.

THE MAIN FALLS FROM CATARACT ISLAND.

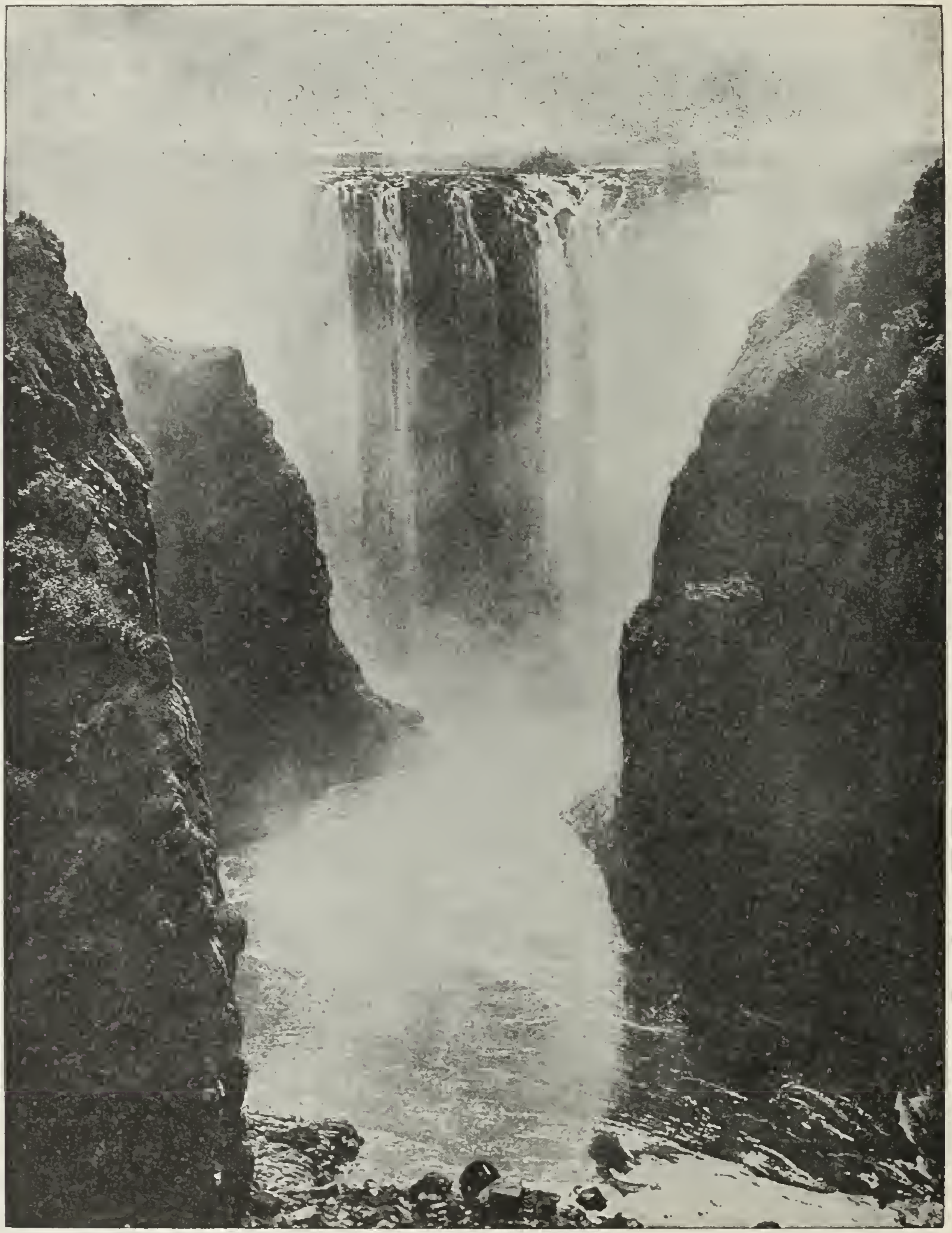
This tract of land is known as the Rain Forest, and in its tropical magnificence, its soft and delicate beauty, can surely be surpassed by nothing on earth. All about the path laboriously cut through its jungles, rise the trunks of splendid trees, which seem to tower into the very sky; their stems, and the earth about them, are hidden in masses of giant ferns, whose long sprays sway and quiver continually under the weight of the falling drops. Strange plants of many kinds grow here; orchids droop from the trees, and palms raise their graceful heads from out the tangle. Through it all drift the rainbow vapors, and from between the trees the sun strikes in long, slanting rays, and lights up the wet vegetation, the rising mist, the falling raindrops, with an effect so tenderly and unutterably lovely that it often brings tears to the eyes.


THE FIRST ZIGZAG OF THE ZAMBESI RIVER BELOW VICTORIA FALLS.
From a photograph by Ellerton Fry.

In places the forest is more open, and here the giant Rhodesian grass grows, twelve feet high, its flower-heads heavy with wet; and palms, free from the jungle and able to grow as they will, rise thirty feet into the air, their every fringed leaf hung with gems.

At any time a few steps will take the traveler from out this Forest of Rainbows, to where he may stand on the very verge of the terrific Chasm. Here he is directly opposite the Falls, which come rushing over the further tip in a mass of foam as white as snow, to fall with a roar more than four hundred feet into the dreadful abyss. By leaning over, it is possible at times to see the river at the bottom, a boiling, turbulent torrent racing furiously to the right along its rock-bound bed; but more often all is hidden in the mist, which is hurled upward so densely that in places the Chasm seems choked with it, and it rushes past the observer with an audible sound and a suggestion of irresistible force, awe-inspiring to a degree. Opposite the Main Falls, a spot known to the natives as Shongwe, the Caldron, it is so heavy as to blot out sky, forest, and even the Falls themselves, and we are in a strange twilight, half smothered in vapors and wholly deafened with the thunderous roar of the Falls so close at hand.

Everywhere are double rainbows of surpassing brightness, sometimes arches, sometimes complete, glowing circles. They are so close, one may watch their melting colors as in a soap-bubble; and they move and change continually with the sun or the movements of the spectator. They gleam softly in the cloud, brilliantly against the stern black cliffs; and tiny rainbows by hundreds dance in the falling sheets of water and among the palms and ferns of the forest.



VICTORIA FALLS, TAKEN FROM A POINT JUST OPPOSITE THE EXIT FROM THE CHASM.
From a photograph by L. Pedrotti.

A strange circumstance cannot fail to strike the observer, and awe him, as perhaps nothing else could, with a sense of the vast depth of the fissure into which he fearfully gazes. The spray and rain bring into being hundreds of streams, which flash over the edge of the cliff opposite the Falls in an eternal effort to rejoin their parent river. But they never reach the bottom. Long before they are half-way down, they vanish, dissipated once more into spray, and borne upward in the form of lighted mist.

Of the radiant beauty of the whole scene, one writer, a traveler of renown, says:

"I believe that on that day I was gazing at the most perfectly beautiful spectacle of all this beautiful world.

"As the sun's rays fell on that kaleidoscopic, ever-moving, changing scene, made up of rock, water, mist, and shivering foliage, the coloring of it all was gorgeous, yet of sweetly tender tints under that luminous, pearly atmosphere formed by the spray-mist. Below, where one caught glimpses of the rushing water, it was turned brown and golden, blue and rich dark green. The cliff, sparkling with dripping water, was of shining black and glowing bronze. The foliage of the Rain Forest was of the green of an eternal spring, and a myriad jewels of twinkling light were made by the water-drops on the trembling leaves. A glorious rainbow spanned the Chasm; and other rainbows flitted in the haze. As for the tender, pale beauty of the Cataract and of the luminous, pearly mist, no words could convey it to the imagination."

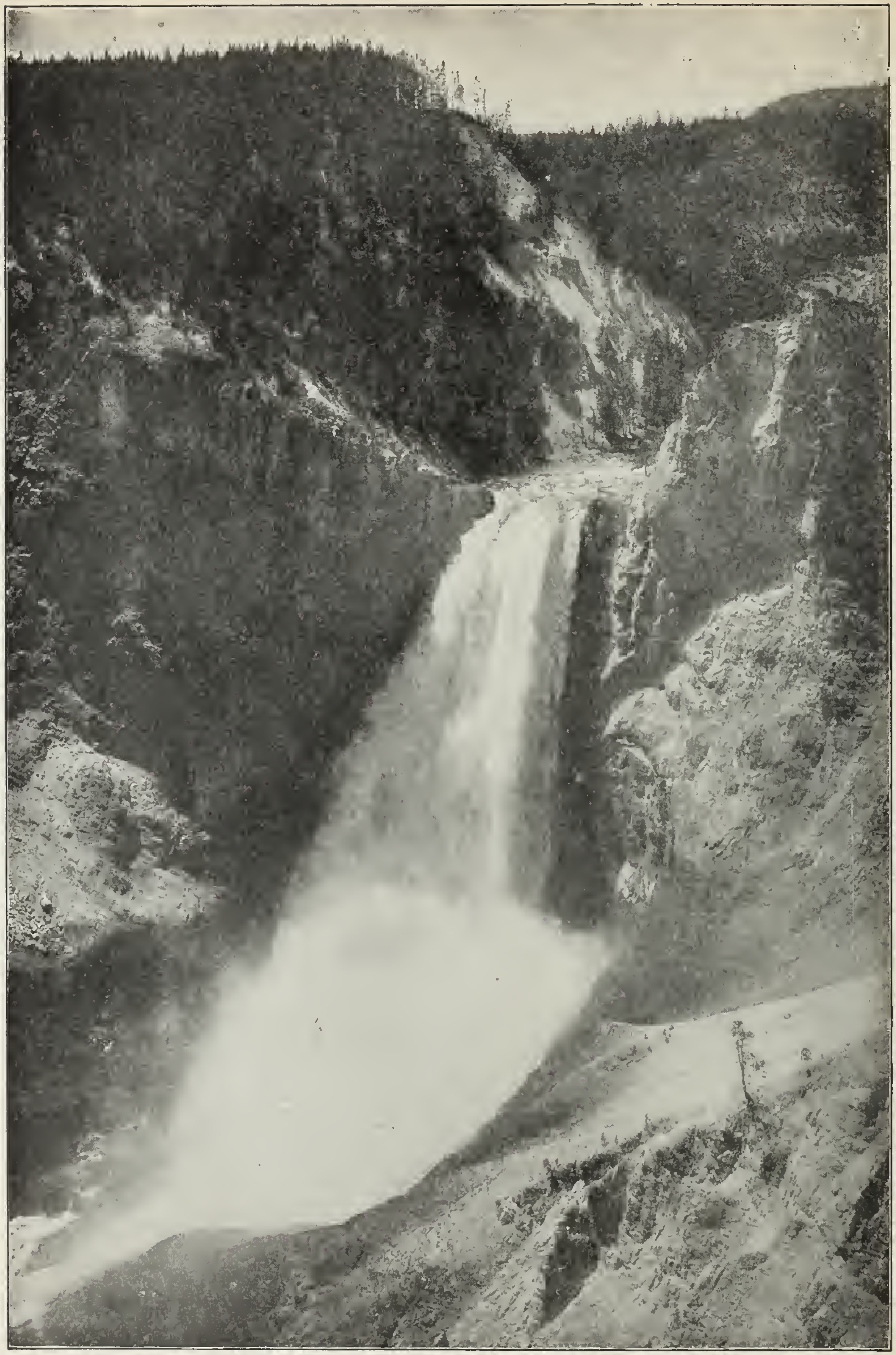
Another writer says: "The beauty of the pearl-tinted atmosphere, and the glory of the dazzling rainbows, are the first and the last impressions that the Victoria Falls give to the mind."

The eastern extremity of the cliff opposite the Falls is known as Danger Point; and here the Chasm turns abruptly at right angles, and becomes the famous Gorge which for fifty miles zigzags across country, with the Zambesi like a silver cord at the bottom of it. Just at the turning-point, a mass of rock has fallen from the cliff and lies below in the river—a mass which, it is interesting to note, Livingstone describes as just *ready to fall,* and which in his drawing of the scene is represented as almost parted from the rest. Along the Gorge a strong, cold wind blows always, and bears the mist as far as the railway bridge and the exquisite palm groves near it.

Above the Falls, the scene is scarcely less fair. Here lies the broad Zambesi, placid and calm under its sunny skies, with its fifty islands, palm-crowned, wonderful, kept ever green and spring-like by the soft spray-showers. On the banks grows the burly baobab, whose trunk is as large as a house; lovely forest fringes either shore, and gay-plumaged birds flit among the flowering trees and feast on the plentiful wild fruits. From here the mists of Victoria take the form of five towering pillars, bending with the wind, white below, but dark farther up, where they condense into rain. Livingstone says of the river at this point: "No one can imagine the beauty of the view from anything witnessed elsewhere. It had never been seen before by European eyes; but scenes so lovely must have been gazed upon by angels in their flight."

The monstrous footprints of the hippopotami are thick along the banks, and crocodiles lie sunning themselves in the open spaces. Tiny gray monkeys, with wise black faces, swing from the miles of creeper which festoon the trees. Green parrots shriek, and strange great reptiles crash a path through the tangle. The savage natives punt or paddle their dugouts on the placid bosom of the river. So recent is the white man's advent that the whole is scarcely changed from the day when David Livingstone first looked upon it and realized, with beating heart, the Wonder he had found.

THE EDGE OF VICTORIA FALLS, AS SEEN FROM A DISTANCE.
From a photograph by L. Pedrotti.



LOWER FALLS OF THE YELLOWSTONE.

THE WORLD'S GREAT WATERFALLS AND THEIR POWER

THE waterfalls of the earth have become the subject of a conflict which is yearly increasing in violence. The lovers of nature wish to preserve the waterfalls in their original condition as far as possible for all time, while the engineers and industrial promoters seek to use them as sources of cheap power for the production of electricity. The accomplishment of this object on a large scale necessarily involves serious injury if not total destruction to the waterfalls, which are rightly regarded as picturesque additions to the landscapes.

It is only within recent years that waterfalls have been considered from a commercial point of view, but since it has been recognized that the energy of flowing water furnishes a cheap and almost inexhaustible substitute for coal, which is yearly becoming more costly and more largely consumed, the great waterfalls, which as impediments to internal navigation have hitherto been worse than worthless from the viewpoint of social economy, have suddenly become objects of very great value.

The falling water drives the turbines of electrical power-stations, producing electric light and power, which in many cases are transmitted over hundreds and even thousands of miles. The war over the waterfalls which is now being waged by the friends of nature and the promoters of industry is likely soon to increase in bitterness, for many celebrated falls have already been destroyed or have at least had the flow of water greatly lessened by the establishment of power-stations.

The famous falls of the Rhine at Schaffhausen are at present the subject of heated controversy. Several power-stations already stand on their banks and sap their life-blood. The Swiss government, however, takes care to preserve a sufficiently large volume of water to maintain the character of the country's falls as notable spectacles and as attractions for tourists. A still more bitter strife has been engendered here in America by the question of the preservation or destruction of the Falls of Niagara. These famous falls have already narrowly escaped entire absorption in the pipes of power-stations, and very energetic action on the part of lawmakers both in the United States and Canada has been required to keep intact from industrial invasion, and preserve in its original beauty, at least a remnant of this great wonder of the world.

Another North American waterfall, which as the highest fall in the whole world especially deserves preservation as a natural monument, is apparently assured against destruction for all time. This is the Yosemite Fall in California, which makes a descent of 2600 feet in three successive stages. As the whole Yosemite Valley, which was not discovered until 1851, was made a national park in 1864, the falls of the Yosemite are under governmental protection and their pristine beauty can never be marred by the establishment of any power-station.

There is a popular but erroneous impression that the Falls of Niagara are the greatest in the world, and even those more enlightened persons who know that the Victoria Falls of the Zambesi River in Africa are twice as broad and more than twice as high as those of Niagara, almost invariably assign to Niagara the second rank among the great waterfalls of the earth. Even this is an error, for South America possesses a waterfall which exceeds Niagara both in width and in height and is actually the second largest waterfall in the world.

This little known waterfall is that of the Iguassu River, tributary of the Parana, and like Niagara it is situated at the boundary of two states, each of which owns half of it. The total water-power of the Iguassu Fall, which is 213 feet high and nearly two miles wide, is estimated as about 14,000,000 horse-power. This is approximately equal to the aggregate water-power of all Scandinavia, which is rich in waterfalls, or about ten times the total water-power of Germany. The temptation to exploit this great, inexhaustible, never-freezing stream as a source of power for industrial purposes may easily be imagined.

At present such exploitation is quite impossible, as the Iguassu Fall is too far from the beaten tracks of commerce to make it profitable to establish any electrical power-station, but probably it will not be long before these falls will be threatened with the fate of Niagara. This undesirable possibility has been foreseen by the interested states, Brazil and Argentina, which have already begun negotiations designed to protect the falls.

The largest of the earth's waterfalls, the Victoria Falls of the Zambesi River in Rhodesia, which are 386 feet high and more than a mile wide and which were discovered by Livingstone in 1855, have also become the subject of a compromise between the conflicting demands of the lovers of nature and the promoters of industry. The water-power of these falls is estimated to be fully 35,000,000 horse-power, two and one half times that of the Iguassu and five times that of Niagara. By way of comparison it should be noted that the aggregate water-power of the whole of Europe cannot greatly exceed 35,000,000 horse-power.

It is certainly possible to derive a few million horse-power from this great fall without appreciably detracting from its majestic beauty. The demands which are made at present are still more modest. The Victoria Falls Power Company ask for only 150,000 horse-power, less than one two-hundredth part of the whole, and the plans for the future development of the station involve no danger of the annihilation of the falls. The British government and the colonists know very well that the Victoria Falls, which since 1905 have been easily reached by the Cape to Cairo Railway, which crosses the Zambesi immediately in front of the principal fall, will certainly bring as much money into the country by attracting tourists as by producing electrical power.

There is no other waterfall in the world which is at all comparable in greatness with the Zambesi, the Iguassu, or the Niagara. Asia, notwithstanding its colossal mountain-ranges, is comparatively poor in large waterfalls, which are found most abundantly in Africa and North America. The largest African streams especially are interrupted by many falls of considerable height. The Congo has several high falls which, owing to the great volume of the river, about sixteen times that of the Nile, may be counted among the most important sources of water-power on earth.

The Stanley Falls, in the middle reach of the river, consist of seven successive falls, of a total height of 164 feet and a width of nearly 4000 feet, and offer an exceedingly rich source of power which probably will soon be exploited. Still more important is the total water-power which the Congo develops in the non-navigable section extending from its mouth to Stanley Pool. Here the river, confined in a channel only a few hundred yards wide, and with a depth of water of nearly 300 feet, flows with a velocity of 48 feet a second, so that at every point of the stream 25,000 to 30,000 cubic meters, or about a million cubic feet of water, are hurled along with irresistible force, while thirty-two rapids and waterfalls lower the level of the stream by 820 feet in a stretch of 170 miles.

The lower Nile in Egypt possesses a series of rapids, the celebrated cataracts of the Nile, but no waterfall in the strict sense of the word. True waterfalls occur on the upper Nile, the most beautiful of them at the point where the stream issues from Victoria Nyanza. This Ripon Fall is only a few yards in height, but the volume of water is so great that it presents a magnificent spectacle.

Comparatively few persons know which is the highest waterfall in Europe. The most voluminous of European waterfalls, strictly so called, are the Rhine Falls at Schaffhausen, but the highest are the Rjuken Falls of the Maan-Elf River, in the Norwegian province of Telemarken. The principal fall is 800 feet high and the total height of the two chief falls with the intervening rapids amounts to 1837 feet, while the average flow of water is 50 cubic meters, or 1760 cubic feet, a second. The Rjuken Falls, with their total energy of 250,000 horse-power, are already things of the past, for they have been irrevocably given over to industrial uses.

A similar fate threatens other small Norwegian falls, but Norway is so rich in waterfalls that it can well spare a few. In Sweden, likewise, the Falls of Trollhatta, the most celebrated of all Scandinavian waterfalls, have been almost entirely annihilated as objects of natural beauty. Nearly all of their water is now employed for the production of electricity.

The largest and most beautiful of these falls is the celebrated Harsprang, which forms the subject of many legends. The Porjus power-station is expected to reach completion in 1914, and to develop soon afterward about 80,000 horse-power, yet the wild beauty of the Porjus Fall will be little affected, as it is estimated that its total water-power in summer, after its sources of supply have been regulated, will be about 300,000 horse-power.

In the Porjus Rapid the river descends 164 feet in about 2 miles. The Harsprang is also half waterfall and half rapid and accomplishes a descent of 244 feet in 1¼ miles. The Harsprang would therefore yield more power than the Porjus, but it is to remain untouched for the present.

Even little Finland is endeavoring to preserve her natural beauty and has decided to keep her greatest waterfall in its original condition as a natural monument and to allow no large power-station to be erected on its banks. This fall is the celebrated Imatra Fall of the Wuoxen River. The total descent is only 66 feet in 2 miles, but the volume is very great and the depth considerable, while the width of the stream contracts from 570 to 150 feet in the course of the falls.

INTERESTING QUESTIONS AND ANSWERS

HOW DOES A TRAIN KEEP ON THE RAILS?

We all think we know the answer to this question, and we are nearly all wrong. If you look at the wheels of a train you will see that they have a rim, or flange, on the inside, and people think that this keeps the train on the rails. If that was all there were, not a single train in America would ever reach the end of its journey. The real reason is in the way the wheel is made. The wheel where it runs on the rail is cut slantways. If it were cut flat, so as just to fit on the rail, no flange would ever keep the train on the rails. But the wheel cut slantways does what is wanted, because it is harder work for the wheel to ride on the part near the flange than on the part away from the flange.

That is to say, it is easier for the wheel to run where it is smallest, and the wheel is made smallest on the outside edge, so that both wheels press *outward,* as it were. This means that if one wheel is pressing too far outward the other is pressing *the other way,* and so the two wheels keep each other right. The wheel is really made up of several wheels together, the outer being smaller than the inner, and it costs the engine less work if the train rides on the smallest wheels—that is, if the outer part of the wheel-edge rides on the rail. Moving things always do the least work they can; that is to say, they always take the path of least trouble—like most little boys and girls, and grown people, too.

WHY DOES A GALE BLOW GREAT TREES OVER AND LEAVE RUSHES STANDING?

Well, you might add, not only rushes, but also some kinds of trees, like the willow, which bend before the gale just as rushes do. The reason depends upon the difference in the wood of various trees; some are elastic, and some are not. The tree which is not elastic, but rigid, like the oak, will stand unmoved, so far as its trunk is concerned, in a very strong wind, though far less wind will make the rush or the willow bend, because it is nothing like so strong. But if the wind becomes a great gale the oak will break; the willow and the rush will bend as they did in much less wind, and when the gale is over they will come upright again, because they are elastic. If you strike a piece of string with a stick it will bend, but will not break; if you strike a thin stick with a thicker stick, the thin stick will break. That is what happens in a gale of wind.

There are people who are like the oak; they are strong and can stand a great deal, but they are rigid, and do not know when to yield or give in, and the time will come when they will, so to speak, break, while other people who are less strong will recover. But the wisest people and the strongest have the advantage of either the oak or the rush, for they can be strong as the oak when it is necessary, and can give in gracefully when that is necessary. Many great men in history were like this, but many bent and gave in to save themselves, even at the cost of their honor, when it would have been nobler to break altogether, even though that meant losing all their power.

WHAT IS SMOKE MADE OF?

Smoke is the result of imperfect burning. Most of the things from which we get so much smoke—like coal—if they were properly burned, would form nothing but gases, which we could not see, and which would very soon fly away and do no harm to anybody. But in order to burn coal properly some trouble and care are required. When we burn coal in an ordinary fire, we do not supply enough air to it. We put the fresh coal on at the top instead of at the bottom, as we should, and so we only partly burn the coal, and small specks of it, unburned, are carried up in the draught, and make smoke. The chief stuff in smoke is simply coal, in specks of various sizes. But the trouble is that a great deal of oily stuff comes out of the coal, and covers the specks of it in smoke, so that these stick to things. We all do wrong in this respect in our fires at home, and the time will come when we shall make our fireplaces differently, so that we can burn our coal in a better way.

At present the smoke makes black fogs in many cities, and cuts off a great quantity of the daylight by which we live, besides making everything dirty, destroying plants and trees, and filling our lungs with dirt which we never get rid of. There are few things about which we are more careless than smoke, and if we had sense enough we should stop making it, even if it were only for the reason that all the stuff in smoke might be burned, and that so in making smoke we waste a great deal of our fuel.

WHY DOES THUNDER FOLLOW LIGHTNING?

Light travels more quickly than sound, and in this fact we find our answer to this question. The lightning is made by the movement of electricity in the air, usually between two clouds. This movement makes heat as well as light, and the heat causes the air close by to spread itself out, and this starts a great wave of air—which is the noise we call thunder. This noise, or sound wave, comes after the light wave, simply because sound waves move more slowly than light waves.

Now, here is something that will be of use to you in the case of a thunderstorm, especially when people are frightened, as many children are if they have been told foolish stories, and as some children and even grown-up people are, stories or no stories. For when there are some seconds between the lightning and the thunder, we know that the storm is really far away. The farther the storm, the longer the interval between the lightning and the thunder; and you can comfort frightened people who think the electricity in the storm may hurt them by showing them that it must really be far away, since the sound comes so long after the lightning.

WHY DO BIRDS NOT FALL TO THE GROUND?

We know, of course, that there is such a thing as the air, a great ocean just as real as the ocean of water; and the flying of the bird is really very like the swimming of the fish. But, of course, if a bird stops flying it will drop, for its body is heavier than the air. Though the bird's body is heavier than the air, yet it is very light, and is most beautifully made, so as to be as light as possible. There are great spaces in its body which are filled with air, and its bones are light though very strong.

Still, though this helps the bird, of course, yet all the same its body is heavier than the air, and it will fall unless it uses its wings. The bird knows this, and sometimes it wants to fall quickly. It folds its wings and simply drops as you or I would if we fell out of a balloon. The strongest muscles in the bird's body are those which press the wing downward, and if it uses them quickly enough, this keeps its body up or even raises it. When we swim we do what is really just the same thing, though it is not nearly such hard work to swim, really, as it is to fly. No machine that man has ever made is as clever as a bird for flying, because there is no machine in the world that can do so much work as a muscle in proportion to its weight. If only man did not have to take with him up into the air the engine that gives him his power, then he could make flying machines easily enough.

WHY IS IT COLDER ON A MOUNTAIN-TOP?

You think, perhaps, that as you are nearer to the sun you ought to get hotter. It is true that as we get nearer to the sun we must get hotter, unless something else is working the other way at the same time. But the highest mountain on the earth is not seven miles high, and as no one has ever been to the top of it, and as seven miles is not much worth mentioning, seeing that the sun is more than ninety millions of miles away—well, you cannot expect to gain much by climbing a mountain. For the matter of that, the earth is much nearer to the sun in winter than in summer, but the sun is so far away that that makes little difference.

But now you want to know why you get colder. It is because the warmth that we live by is mostly in the surface of the earth, though doubtless most of it has come from the sun in the first place, and the air, besides being necessary for us to breathe, is also a great blanket that keeps in this warmth. When we climb a mountain we pass through the densest part of this blanket, and pass away from the warm crust of the earth, and so we get cold.

It is just the same when men go up in a balloon. On the other hand, if you go down into a coal-mine you get hot, though if you do so in the daytime you are actually going farther from the sun. We should all be frozen to death in the night if it were not that the earth is warm itself, and that the blanket of air keeps the warmth in for us.

WHY DO WE SEE THE FLASH FROM A GUN BEFORE WE HEAR THE NOISE?

When the gun goes off it produces at the same moment *light*, which makes the flash, and *sound*, which makes the report. Light is a wave in something which is everywhere, and is called the ether; and sound is a wave in air.

Like all waves, in water, or air, or ether, these waves take time to travel. But sound waves travel very slowly compared with light waves. Sound moves only some hundreds of feet in a second, while light will go more than 180,000 *miles* in a second! If you are very near the gun you will hear the report and see the flash so nearly together that you cannot say which was first; but the farther you are from the gun the greater will be the difference of time, because the light reaches you so quickly, while sound comes lagging after it. You will see the flash always within a tiny fraction of a second after it happened, but the sound wave may take a second or two to reach you if you are far away.

Just in the same way, if you watch a game of baseball from a distance, you will *see* the bat hit the ball, and then, afterward, you will *hear* the bat hit the ball. Light travels from the sun in about eight minutes, and from the nearest star in about four years. Sound never reaches us from the moon, or the sun, or the stars, because there is no air in between to carry it.

WHY ARE TEARS SALT?

Now, you will say that there can be no harm in having sweat in our eyes, at least a little of it, since we have tears in our eyes, and they do not hurt us. But there is a great difference.

Tears are made to wash the eyes, and there is no poison in them. In fact, if you took just the right quantity of ordinary table-salt, and melted it in perfectly pure water, you would have something almost exactly the same as tears; and we know also why it is that pure water without any salt in it would not do for tears. Quite pure water is found to injure *all* delicate living things, like the front of the eyeball, and it is not natural to the body. The natural kind of water in which every part of the body lives its life is salt water. If you melt the right amount of salt in water, you have something which men who study these things call "normal salt solution," meaning that it exactly suits every part of the body, neither exciting it nor weakening it. This normal solution, which is just the same as tears, is used when we are studying any part of the living body; and it is used by surgeons rather than pure water, and all for the same reason. So next time you help yourself to salt you will know where some of it goes, and why your body needs it.

WILL THE CHILDREN RULE THE WORLD?

It is really true that the children of to-day will rule the world to-morrow. There is nothing we know better than that all men and women, kings and beggars, great and small, began as helpless babies, more helpless than any other kind of living creature, and there is nothing we more constantly forget. All individuals are mortal, and the destiny of the world, the ruling and the being ruled, is all in the hands of the children. Those who rule to-day were the children of yesterday, and will be dust to-morrow. That is the law of human life. It means that "a mother is the holiest thing alive," that history is made in the nursery, that the bringing up of children is the noblest, the purest, and the most necessary work in the world. And it is the most difficult, just because the human being is so wonderful and complicated in the nature of his mind and his body. When at last men come to see that real patriotism, real love of one's country, means, before all things, strengthening and ennobling its human life, and that, since we all must die, this means living to serve children—then not only shall we have the world ruled for children, ruled so that they shall be rightly prized, and nourished, and guided, and loved and taught, but also these children will, in a few years, grow up, and the world will be ruled by them. The writer has two little daughters. He knows that the highest thing a woman can be is a mother, a maker of the life of mankind. He hopes that they will one day have children; and he lives and works to teach all who will listen, so that the children of to-day, and their children, may live in a better world, where no child starves, or cries, or works, or dies, or is afraid, or cold, or lonely.

WHY IS THE COUNTRY HEALTHIER THAN THE TOWN?

The country is healthier than the town only for two reasons, but they are very important. They are that the country gives us purer air to breathe, and more sunshine, as the country air is clearer and does not stop so much of it as town air does. On the other hand, the towns are usually much better off than the country in the matter of sewers and of water. Further, if people are wise and reasonable, it is better for their health of mind to see *not too few* people, and to be not too much forced in upon themselves. In this way the town is better than the country; and it is a fact that there is more insanity in the country than in towns. It is foolish to abuse cities blindly, as many people do. Civilization really means *city-fication.* There never has been a civilization without cities. Athens, and Rome, and Jerusalem, to which we to-day owe almost everything, were cities.

The time will come when people will see this, and will try to make their cities as healthy as the country in air and sunshine. They will not allow each other to make the air impure, and so they will get better air into their lungs and more sunshine; they will build all houses with gardens; they will stop the unnecessary noises of cities; and so will make places where men can meet, and gather, and mix, and make music, and hear each other speak, and discuss things, and do everything which men must do together—while they will keep the advantages of the country.

WHY IS IT THAT SO MUCH OF NATURE IS GREEN?

Wherever life can find a footing in Nature, there we find it. It varies in a thousand ways, but we find it almost everywhere. It is always limited, and decided by the food supply; and thus we find it most abundant where the food supply is most abundant. Thus, the distribution of living things depends on the distribution of the kind of food that they live upon. If that is widely distributed, so are they; if the food is not widely distributed, neither are they. Of all the possible foods for life, by far the most widely distributed is carbonic acid, as that occurs in the air, and so is to be had wherever the air is. Thus, the most widely distributed kind of life is that which is capable of feeding on carbonic acid, and the only kind of life which can do this is that which produces the green substance called chlorophyll—one of the most important chemical compounds in the world. That is the reason why so much of Nature is green. And if we know the relation of the green plant's life to our own, we should learn that there *must* be a certain amount of green life in Nature, if we are to live. At present we destroy green fields and cut down green trees without any thought—for our cities, and tables, and so on. But much of Nature must always remain green, unless man learns how to use the carbonic acid of the air as the green plant does; and of that he shows no sign at present.

WHY SHOULD LIGHTNING STRIKE CERTAIN THINGS AND NOT OTHERS?

We know that if lightning can choose between a lightning-rod—that is to say, a rod of iron—and the rest of the roof of a house, it will go down the rod. We know that it will always choose metallic things rather than any others. And it will strike a tree rather than the ground beside the tree. In every case the principle is the same. It is that electricity will always choose the easiest path. The usual way of saying this is that it takes *the path of least resistance,* and the principle is true of many things besides electricity. It is often true of ourselves. Thus, if the electric current can pass to the earth through a tree, it will do so, because the tree helps its passage downward. That is why we should never stand under a tree during a thunder-storm. But, for choice, it will always pass through anything made of metal, such as iron, for the whole group of metals are good conductors of electricity—the best there are. We do not know *why* they conduct it so well, but we do know that that is the reason why lightning chooses to pass through them. So a lightning-rod will protect a house, provided that it runs right down into the earth. If the lower part of the rod has rusted away before it reaches the earth, as sometimes happens, the electricity will be discharged into the house, and then the rod does more harm than good, for it attracts the lightning to the house, and does not protect it.

WHY DO I JUMP WHEN I GET A SHOCK?

The jump when we get a shock, or the closing of our eyelids when something comes near to them, is called a reflex action. Reflex actions are constantly occurring in our bodies, and in those of all living creatures, and we could not live without them. They are called "reflex" because the action follows at once on the thing that excites it, almost as if it were a ball or something reflected from a wall. The mark of a reflex action is that the *will* is not concerned in it; and that is the whole point of this question. We do not want to jump, we do not make up our mind to jump, but we jump first, and then notice that we have jumped. The will does not cause reflex actions, but it can often control them if it has time and warning given to it.

That is why we jump at an unexpected sound, as when someone bangs a door; but not at an expected sound, as when we bang the door ourselves.

WHY DOES A BICYCLE KEEP UPRIGHT?

In answering this question, we may teach ourselves the way in which we try to solve questions like this. We know that the bicycle does not keep upright when it is still, but it does so when it is in motion. The same is the case with a hoop. The more a bicycle or a hoop moves, the more surely does it tend to keep upright. There must be something, then, in the nature of motion that keeps the bicycle upright; not something in the bicycle itself, or else it would keep upright apart from its motion. When we have gone so far as to realize this, we may hope to find the answer to the question, for we have our attention fixed on the point which contains the answer. Now let us consider what we know about motion, and see whether that will explain this case.

Newton's first law of motion must be the answer. This says that a *moving* thing will move at a constant speed *in the same straight line* for ever, unless it is acted upon by some other force. That is what happens to the bicycle or the hoop. It is a *moving* thing, set moving in a certain direction, and, according to the first law of motion, it *must* go on moving in that same line until something interferes with it, and so it keeps upright.

HOW DOES THE SUN MAKE A MAGNIFYING GLASS BURN A PIECE OF PAPER?

This question would be better put the other way round—how does a magnifying glass make the sun burn a piece of paper? Just in the same way, we say, that the sun makes the green stuff of the leaf decompose the carbonic acid of the air, but we should say that the sun does it by means of the leaf. Always the sun is the real cause. In this case it is the concentrating power of the lens that helps the sun. We know that when light passes through a convex lens it is bent toward the thickest part of the lens—which is the center—and that the rays are all brought to a point, which is called the *focus*. We see this when we make the experiment of burning paper. We see the light brought to a focus, but it is not the light that burns the paper. If, instead of the glass, we had a hollow globe filled with cold water, kept changed, the light would be thrown on the paper just the same, but it would never burn. It is the heat-rays of the sun that burn the paper, and the interesting thing, which we must be careful to remember, is that heat-rays are bent by lenses exactly as light-rays. The two kinds of rays obey exactly the same laws, which is natural enough, since they are varieties of the same thing, though we happen to feel the one and to *see* the other. Of course, no heat is made out of nothing in this case, or in any other case. The paper round the bright center loses the heat which the center gains.

IS THE STUFF IN EARTH AND AIR ALWAYS CHANGING PLACES?

There is a ceaseless circulation going on between the surface of the land and the water, and the bottom layers of the ocean of air which covers them both. Wherever water is, for instance, it is often being sucked up in the form of a gas into the air, of which it then forms part; while, on the other hand, water vapor from the air often passes from it to the earth—as, for instance, in the form of dew. Then the gases of the air, especially oxygen and carbonic acid, are ceaselessly passing between it and the bodies of all the living creatures on the earth; then, from moment to moment, various gases are either leaving the air to be dissolved in the ocean, or are leaving the ocean to join the air.

It would be well for us if we could mark an atom of oxygen, and watch it for a year or two, and see all the amazing things it does: passing in and out of the bodies of living creatures, in and out of the earth, in and out of the ocean. Then, if we remembered that all the other atoms of oxygen and of other things, too, were doing the same kind of thing, we should begin to understand how wonderfully alive, so to say, the whole world is. Perhaps the whole world, indeed, is really alive!

WHY ARE ALL THE WORLDS ROUND?

It is true that all the worlds are round, or very nearly round, and that, if they are not quite round, there is a special reason. The earth, for instance, is not quite round, but bulges a little at the Equator, simply because it twists on itself so quickly that it gets a little out of shape. There is something special about roundness, for not only are all the worlds round, but a thing like a drop of water tries to make itself as round as it can; and if you drop melted lead from a height you get round shot. The reason is that in all these cases you have some force trying to pull all the parts of the world or of the drop toward each other. If this be so, the shape which the world or the drop will tend to take will be that particular shape in which everything is as tightly packed as it can be. That shape is the sphere, or, as you would call it, a round ball. If you all want to see a conjuror, and to be as near him as possible, what shape will you form round him? A circle, of course. The conjuror is a center of attraction, like the center of the earth or the sun, round which everything groups itself as near as it can, and so makes a round ball.

WHAT HAPPENS WHEN ANY ONE FAINTS?

Fainting is really a very beautiful and wonderful thing. What happens is that the heart does not send enough blood to the brain, and so the brain stops working, and the person drops to the ground. Now, this is exactly what he needs in order to put him right. When you are standing or sitting up, your heart has to drive the blood upward to your brain against the attraction of the whole earth, which tries to pull everything down. But directly the fainting person falls, the heart's task of sending sufficient blood to the brain is made easy, and so very soon his brain gets sufficient blood, and he "comes round," as we say. If his heart has not been actually strained he is all right again. So you see that the falling is Nature's method of "relieving the situation."

People who have not learned this try to raise up the fallen person, which is simply interfering with Nature's beautiful way and putting his brain in the worse possible position for getting the amount of blood it needs. The right end of a fainting person to raise is his feet, so that little blood shall be wasted on his legs, and so that there shall be plenty to run toward his head, which needs it.

WOULD THERE BE ANY WEIGHT IN THINGS WITHOUT THE EARTH'S PULL?

The answer to this is practically no. What we call the weight of things is the earth's pull for them; and if the earth were to lose its power of gravitation, it would be just as easy to lift a house as to lift a little ball. The amount of matter in things would be just the same as it was before, only they would have lost their weight, or heaviness. So, when we mean to talk about the amount of matter in a thing, it is very much better to use the word "mass" than to use the word weight. The mass of a thing is wholly independent of gravitation, but the weight of a thing wholly depends on gravitation, and cannot exist without it. The mass of a thing is the same whether it be on the earth or the sun or the moon, but its weight would be vastly different in those three cases.

I said that the answer to the question was practically no, but it is not *quite* no, because there is another source of weight in things besides the earth's pull, and that is the sun's pull. Also, there is the moon's pull, and, indeed, the pull of all the other matter in the world everywhere. These other bodies are, however, comparatively so far away that though things would still have some weight owing to their pull, even if the earth's pull were abolished, yet we should scarcely be able to measure it, and certainly could not feel it with our hands. If all gravitation were abolished, nothing would have any weight.

WHY IS THE SNOW WHITE?

You might have asked also why is foam white when a wave breaks. In both cases we know that we are dealing with water, and yet, instead of being transparent, which means that it lets the light through, it is white. We understand at once when we find out what snow and foam are made of, or, rather, what is the state of the water that makes them. In the case of snow, the water is frozen and forms tiny little crystals of beautiful shape.

These all lie loosely together, forming the snow, and though, if you could take one of them by itself, light would go through it just as it will go through a piece of clear ice, or many other crystals, yet when you have a heap of crystals lying together, all turned different ways, they throw the light back in all directions, just as salt does. They do not keep any part of the white light that falls on them, but throw it all back, and so snow is white. But, of course, if you have colored light falling on the snow, then the snow throws back that same color, and this gives some of the most wonderful sunset effects upon snow-covered mountains.

DO PARROTS KNOW WHAT THEY ARE TALKING ABOUT?

I believe that no parrot knows in the least what it is talking about. The parrot has keen ears and a clever brain, so that it hears very distinctly words uttered in its presence, and so that it can reproduce with its throat and tongue and beak many of the sounds which it so cleverly hears. Of course, this is a very different thing from an echo, but so far as attaching any meaning to the sounds is concerned, parrot speech is only echo speech.

Small children reproduce words which they do not understand in just the same way, and I am afraid that grown-up people do so, too, sometimes. If we could believe that a parrot understood what it said, we should have to put the parrot on something like our own level in the scale of being. But we find that all words are just the same to a parrot, and it will repeat a word like algebra, shall we say, or hypnotism—if it hears it often enough—just as readily as it will repeat "pretty Polly." It is just a living echo, and no more, and the process that goes on in the parrot's brain is no more and no less than what goes on in our brain when we simply imitate or repeat the sounds of words spoken to us in some foreign language of which we know nothing.

WHY CAN STILL WATER REFLECT THINGS FROM A DISTANCE?

The distance from which the light comes has nothing whatever to do with what happens to it. Still water, like many other surfaces, is a very exact reflector of light. It throws the light-waves back from itself without mixing them up or distorting them. So long as it does this, we can see the image of whatever threw the light. It matters not in the least how far the light has traveled before it reached the water. You can see trees reflected in it, but you can see the moon or the sun reflected in it equally well, though they are scores of millions of miles away.

WHY DOES THE ELECTRIC BELL RING WHEN WE PRESS THE KNOB?

We can almost answer this question for ourselves if we have in the house one of those electric bells that one rings by pressing the knob of a little round wooden box at the end of a wire. If we unscrew the top of this little box, we find little pieces of metal inside it, and we see that, when nothing is touching them, they do not touch each other; but if they are pressed upon they do touch each other, and then the bell rings. When we press the knob—though we see nothing—what we do is simply to press these two pieces of metal against each other, and as long as they touch each other the bell will ring. When we stop pressing the knob, the *contact,* as we say, between the two pieces of metal is broken, and the bell therefore stops ringing.

These pieces of metal are connected with wires that run from an electric battery. When they touch each other, the electricity from the battery can run round the wire. As we think of the electricity running round, we call this arrangement an electric circuit. In the course of this circuit, or circle, there is a bell, so arranged that whenever the electricity passes along it, the bell is disturbed and rings. When we press the knob we complete the circuit; when we let go we break the circuit, and then the electricity can no longer run round.

DOES IRON INCREASE IN WEIGHT WHEN IT RUSTS?

We have to find out what happens when iron rusts, and then we shall have the answer to this question. What happens when iron rusts is, that the outside of it, which is exposed to the air, is burnt, or oxidized. A certain amount of the oxygen of the air is added to the iron, therefore. This oxygen, like everything else, has weight, and its weight must be added to the weight of the iron itself when the iron is rusty. Therefore, the answer to the question must be yes. The iron increases in weight by the weight of the oxygen which it has added to itself. But, as every one knows, the rust, or *oxide of iron,* is friable, a Latin word which means crumble-able.

The rust will crumble away under the influence of water or wind or anything else rubbing against the iron, and so the iron thing will lose not only the oxygen that it has taken into itself, but also the part of the iron which has combined with the oxygen. So an iron thing, when it rusts, loses weight, and that is very serious, of course, for it means that the thing loses its strength. And if an iron or steel bridge were allowed to crumble away in this fashion, it would soon break. That is one reason why we must keep such a bridge painted to protect the iron from the air.

WHY DOES YEAST MAKE BREAD RISE AND BUBBLE?

The bread, or, rather, the dough, contains a certain amount of sugar, which has been made in it from the starch made by the wheat plant. Yeast consists of an enormous number of tiny living plants, which produce inside their bodies a ferment—a chemical substance which we have just learned how to separate from the yeast cells themselves; and this ferment has the power of working on the sugar in the dough so that it is broken up and changed into other things. These things into which the sugar is changed are two, alcohol and carbonic acid gas. We lose all the alcohol thus made, for it passes away into the air. The total amount of alcohol we thus lose in a year is enormous, and this is a pity, since we might use it for many purposes, especially for burning in lamps and motor-cars, and so on.

The carbonic acid, as it is formed, makes little bubbles in the dough, and as these get bigger and more numerous, they raise the dough and turn it into bread. We can make bread in another way by forcing carbonic acid into the dough from outside. This is perhaps rather a good way, for it saves the sugar in the bread, and that is a food.

WHERE DOES ALL THE DUST GO TO?

Dust is made of very different things, and its fate varies accordingly. Some dust is mainly made of particles of carbon, and these are gradually washed into the soil by the rain. We do not know whether they are useful there. Some of them get into our lungs and stay there. Then much dust is made of organic matter—substances derived from living creatures, such as horses, for example.

These street deposits of animals are a very important part of town dust. They find their way into the sewers, and so to the sea; or often to the soil, where, like all organic matter, they are extremely useful for the growth of vegetable life. This dust often gets into our eyes and throats, and probably helps to cause the colds that are so common in towns. Town dust will be really healthier when horses, dogs, and cats are kept under better control—if, indeed, they are allowed in towns at all. Also, a considerable part of the organic matter in dust is consumed and oxidized by the oxygen of the air, partly under the influence of the sun, and partly by the action of microbes.

IS THE WHITE OF AN EGG PART OF THE CHICKEN, OR WHAT THE CHICKEN FEEDS ON?

The white of the egg, and very nearly the whole of the yolk, too, are not part of the chicken, but what it feeds on. If we look at an egg that has just begun to develop, we can see just at one point on the surface of the yolk the little thing that will be the chicken; and a day or two later we can see tiny little blood-vessels spreading out from this point over the yolk, so as to help themselves to the food in the yolk. Afterward the white of the egg is also eaten up by the chicken. The white of an egg consists of albumen and water. Albumen means the *white* thing.

This egg albumen is not the same as the albumen which is in our blood and on which our bodies feed, but it is really very similar. When it is eaten up by the developing chicken, or when we eat the egg, young chicken and all, this egg albumen is changed by digestion into the blood albumen of the chicken or of ourselves, as the case may be. As nearly all the egg is nourishment for the young creature that is to develop, different kinds of eggs vary very much in size quite apart from the size of the creature that is to develop from them. Some creatures are born from eggs which contain no nourishment, as the nourishment is supplied in other ways, and such eggs may be so small that they can only be seen through the microscope.

WHY HAVE FACTORIES TALL CHIMNEYS?

We know only too well that the business of the chimneys is to carry the smoke from the furnaces into the air. It may be that if the chimneys are tall, it makes a better draught for the furnaces, but that it is not the important thing. The point is that, according to our present way of burning coal, a large amount of the coal is wasted, and simply blown up the chimney without being burnt in the form of smoke. In the air this injures everybody and everything—men, animals, plants, pictures, houses, and all. But the higher it is sent into the air, the better is its chance of being blown away and thinned out before it settles. Evidently it would not do to have a chimney discharging factory smoke at the level of somebody's bedroom window, for instance.

But I fear that tall chimneys will be wanted—ugly though they are—even when we burn all our fuel in factories in a proper way, and discharge into the air only the gaseous products of its complete burning. Even in the most perfect kind of burning there must always be carbonic acid gas produced, since the chief element in fuel is carbon, and since carbonic acid gas is completely burnt carbon. This gas, which we produce ourselves as we burn, is a poison to us if there is too much of it in the air, and so it must be sent into the air as far away from our mouths as possible.

WHAT DO WE MEAN BY GREENWICH TIME?

It is plain that as the earth spins round the sun must appear to rise in the east sooner the farther east we are, and later, the farther west we are. So the apparent time, judged by the sun's rising and setting, is different in different places, according as they are east or west of each other; indeed, midday on one side of the earth is midnight on the other side. It is not a question of north or south, because the earth does not spin in the north-south line, but in the east-west line.

So it is necessary to have some agreed place from which to take our time, and the place on which many nations have agreed is Greenwich, in England. They have their own time for their own purposes; but for general purposes, as, for instance, events occurring in the sky, they refer to Greenwich time—that is to say, the time reckoned by what the sun seems to do at Greenwich. The lines on maps up and down the earth's surface from north to south are called lines of longitude. They are narrower in the north and south than at the Equator, of course, and meet at the Poles—like the lines usually made by the knife when we cut a melon in the most usual way. Places on the same line of longitude as Greenwich have Greenwich time exactly, and no other place can have it.

HOW BIG IS SPACE?

It is impossible for us to think of space as anything but infinite—something going on for ever. Suppose that with a telescope we could pierce right through space until, in all directions, we came to a great wall, and that was the end of space; yet on the other side of that wall there must be more space, however far away the wall was, and if there were another wall beyond it, there would be more space beyond that. It is impossible to think of space as anything that stops. If there were a boundary no further away than the wall of your room, or a boundary so far away that even light would take a billion years to reach it, in either case we cannot think that there is nothing beyond the boundary; there must be more space. We often say that one telescope has so much space-penetrating power, that another has three times as much power, and so on. Yet, if we could make another telescope with such space-penetrating power—which really means the power to let us see light coming from such a great distance—that the biggest telescope we have, compared with it, would only let us see as far as a worm could see, that telescope would be no nearer bringing us to the end of space than the sight of the worm is. If a thing is infinite, you are no nearer the end of it than you were before, however far and fast you go. A great man has said that this idea of infinite space sometimes impressed his mind so much that he dared not think of it. Yet there is in it nothing to make us afraid, but only to make us thoughtful.

WHY DOES WATER QUENCH FIRE, IF ITS PARTS, OXYGEN AND HYDROGEN, MAKE FIRE?

The first part of the answer is that as the oxygen and hydrogen of water are already burnt up with each other, they can be burnt up no more. If you first of all separated the oxygen and hydrogen, and added the unburnt mixture of them to the fire, then there would be no doubt that they supported combustion, though there would not be much of you left to remember it; and if I thought that you had any chance of making this dangerous experiment, I would not mention it.

The second-part of the answer is that water puts out fire for two good reasons. The reason that every one can understand is that, if a thing is covered with water, the oxygen of the air cannot get at it to burn it. But that is not nearly the most important reason why water puts out fire. It is that water has a great capacity for heat, and can hold a great deal of it. It takes so much heat into itself, and so quickly, that it lowers the hotness or temperature of the burning thing so that it can no longer burn.

WHY IS A SNOWFLAKE LIGHTER THAN A RAINDROP?

A snowflake is made of ice-crystals—that is to say, of solid water. Now, it is a most important and peculiar fact about water that ice is lighter than liquid water, even though it is colder. The general rule, of course, is that things get heavier as they get cooler and lighter as they get hotter, as heat expands them and cold contracts them. But at just near its freezing-point water does not obey this rule; it *expands* as it gets colder and freezes. That is why it bursts pipes in winter. So a snowflake is made of water in a lighter state than the water in a raindrop, and yet another reason why the snowflake is lighter is that there is a great deal of air in among the ice-crystals. This makes the whole thing lighter, just as the air in the holes of a sponge makes it lighter.

WHICH TRAVELS QUICKER—HEAT OR COLD?

This question is one which we cannot ask, for there is no such thing as cold. Complete cold, if we could get it, would only be complete absence of heat; and what we ordinarily call cold is simply less heat than in something else with which we are comparing it. When a thing gets cold, it really gets less hot. So we cannot speak of cold traveling, unless we mean that it is a cold wind that is traveling, or cold water traveling through hot water, as when you run cold water into a hot bath. But we can say how fast heat travels, if by that we mean the rays of heat or radiant heat that we feel near a fire or a light. This kind of heat is really the same as light, and it travels at exactly the same speed, which you know. But cold travels at no speed, for there is no such thing.

WHY DOES THE STREAM RUN MOST SWIFTLY IN THE MIDDLE?

The water at the side of the stream is constantly held back by rubbing against the banks, just as the bottom of a wave is held back when it reaches the shallow water near the shore. And so, compared with the water near the sides, the water in the middle of the stream runs more swiftly. It is held back a little by rubbing, or friction, between it and the slower moving water at the sides; but the friction between water and water is very much less than the friction between water and anything that is solid, such as the banks of a stream.

When we watch the blood running in a blood-vessel, we see exactly the same thing. In the middle of the stream we see the tiny red and white cells tumbling fast over each other as they scurry along. But near the walls of the blood-vessel they move much more slowly, for they are held back by the friction of the wall, even though it is beautifully smooth. And just the same thing happens with smoke going up a chimney, and in many other cases. We should always try to think, when studying such a question as this, of other cases where the same principle of friction is really at work.

WHAT IS THE VALUE OF RUST?

Silver and gold are " noble metals." We know that sulphur compounds act on silver but not on gold. The oxygen of the air acts neither upon silver nor gold, which, as we know, is the reason why they are called the noble metals; but it does act upon iron, especially when water is present. Somehow the water helps the oxygen of the air to attack the iron. When the surface of the iron is burnt or oxidized, it forms an oxide of iron, and that is what we call rust. So iron is not a "noble metal."

But if we think further, we shall see that just because iron can rust it *is* the most noble and valuable metal in the world. If iron were like gold and silver and could not be oxidized, or rusted, we should not exist on the earth, nor would any green plant. It is rusted, or oxidized iron that gives all the color to the good brown earth as well as to colored jewels, like rubies; and it is this rust which gets dissolved by water, and so forms food for the plant, and gives it its green color. It is this rust also by which we get iron into our blood, and which gives it its red color.

So the life of the earth is due to rust as well as the color of the earth. We think rust a nuisance because it spoils our knives; and our forefathers would not call iron a noble metal just because it was liable to rust. But we now know that because iron can rust, because it can be acted upon by the air, it is the noblest metal in the world. John Ruskin says that the iron breathes the air, and so gives life to all of us, and that is a beautiful way of putting it.

WHY DO WE GET A HEADACHE IN A CROWDED ROOM?

We do not get a headache in a crowded room if it is properly ventilated; only, of course, it never is, and if any one of us is the only person in the room, a headache will very likely come on if the room is small and shut up so that the air cannot be changed. There is no question that it is the foul air which causes the headache. The reason why the crowding of people together has this effect is that it is the people themselves who make the air foul.

Every living thing, without exception, gives off to its surroundings, in one form or another, products of its life which are worse than useless to it, and which it must get rid of. The most elegant people, spotlessly clean and scented, are no exceptions to the rule. There is a good deal of doubt as to what precisely the things are which produce the effects of foul air. It is possible that gases given off from the skin, especially if it is not very clean, may contribute.

But probably the carbonic acid which we all breathe out into the air is the chief cause. At any rate, it is certain that the air of an unventilated room soon comes to contain a number of gases which, as we breathe, we get into our blood—gases which have been breathed away from our blood and the blood of other people, and which, as they get heaped up in it, and as they pass through the brain, poison it. Probably they cause headache by weakening the walls of the little blood-vessels inside the brain, so that they get too full of blood, which is moved on too slowly. That causes pain, just as the same state of affairs causes pain in a poisoned finger, or in any part of the body where the circulation of the blood is made to stand still.

WHAT CAUSES A LIGHT TO BE YELLOW?

What we call white light is made up of a vast number of lights of different colors all mixed together in just such a proportion that our eyes call it white. It is almost as if every note on the piano were played at once—with the difference that if this were done our ears would call the sound unpleasant; whereas, when our eyes see all these different kinds of light at once, the result is pleasant. The reason why it is pleasant is that this is the kind of light which the sun gives, and so through long ages our eyes have become suited to it. Now, yellow is just one of the colors that go to make up white light. The waves that make it are quite well known, and are rather low down in the scale of color, like a low note on the piano; while blue, for instance, is high up in the scale, like a high note. Though we say that the sun gives white light, yet really there is rather too much yellow light in sunlight for the result to be quite white.

WHY DOES THE HAIR STAND ON END WITH FRIGHT?

We know that both in ourselves and in many of the lower animals the hair can, and does, stand on end with fright, almost "like quills upon the fretful porcupine," as Shakespeare says. It is also true, as he says, that it is possible for "each particular hair to stand on end," for we find that every hair has the power to do this, and that what happens is not that several hairs stand up together as the result of pulling on the skin. At the root of the hair we find a tiny muscle so arranged that, while the hair usually lies slantwise, when this muscle pulls, the hair stands upright.

The best reasons we can give for this peculiarity are that this movement may help to keep the root of the hair in order by a sort of massage, or that it may serve in keeping the skin clean, or, most likely of all, that it may make such an animal as a cat, when its hair is standing on end, look very much bigger and more terrible to an enemy.

HOW DID ALL THE METALS GET INTO THE EARTH?

If this question had been asked years ago, no one could have made any better answer than that the various metals were in the stuff from which our earth was formed ages ago, and that by some chance or other they just settled down in the earth's crust—one here and one there. But quite lately we have had to give up for ever ideas of this kind.

We are beginning to understand that change is going on everywhere. This is true of worlds; it is true of plants and animals; it is true of nations and their ways; and, for instance, it is true even of the atoms of the elements. So now, when we find gold in some part of the earth's crust, or silver, or lead, or whatever it be, instead of saying that these were always there, we inquire into their history and find out how they came to be made, just as if we were studying the remains of some animal or plant.

For instance, we have little doubt that all the lead in the world is the result of a long series of changes that began in an element called uranium, and that stages in between uranium and lead are represented by the element called radium and the beautiful and precious metal which we call silver. It will not be very long before chemists are able to work out the history of many metals, and even to discover what will happen to them next.

DO THE STARS FALL?

The things that fall, and are called falling stars, are really not stars at all. If a real star fell into the earth—or, rather, if the earth fell into a star—we should all be burnt up by the heat, long before the earth and the star could meet each other. The things that fall are really quite small stones, or pebbles, or balls of iron and other elements. They sometimes fall all the way to the earth, and can be picked up afterward. By far the greatest number of them, however, never reach the surface of the earth as stones, or *meteorites,* at all, for they are burnt up, or broken up, into dust by the earth's atmosphere; and a very great deal of the dust in the air, especially in the higher levels of the atmosphere, is made of this meteoric dust, as it is called by men of science.

We see only a few of the falling *stars* that are caught by the earth's atmosphere. For one thing, though they are falling all the time, we never see those that fall in the daytime. They are always made bright and hot as they pass through the air, but they are not nearly bright enough for our eyes to notice when the sun is shining upon our part of the earth. But, as these things are always reaching the earth, and as no matter can be destroyed and made into nothing, quite a lot of the present matter of the earth has been derived from meteors, or falling *stars,* in this way. The dust of them can sometimes be found lying on the snow of the highest mountains where no other source of dust, such as smoke, is at work to produce it.

WHY DOES LIGHT TRAVEL QUICKER THAN SOUND?

We might reply by asking: Why should light and sound travel at the same rate? or: Why should not light travel slower than sound? If light and sound were waves of the same kind, traveling in the same thing, then it would certainly surprise us if they did not travel at the same rate, and we should want to know the reason why.

But light and sound waves are entirely different from one another, and they travel in utterly different things. Sound travels in gases, such as the air, or in other material things, such as water, or even in solid things. Its speed varies according to the kind of thing it travels through, according to its temperature, and so on. But light travels in something called the ether, which is far more different from any ordinary matter, whether solid, liquid, or gaseous, than we can imagine. The ether is intensely elastic, and so carries light through it faster than any waves can travel through ordinary matter. No difference in temperature seems to have any effect on the properties of the ether, and so light always travels through it, so far as we know, at exactly the same pace, no matter what the kind of light is—red, or green, or blue. So, also, every kind of ether-wave, light, radiant heat, or electricity, travels through the ether at exactly the same rate of speed.

CAN PLANTS BE GROWN BY ELECTRICITY?

It has been thought for some time that the passage of electricity from the air to the earth, which is probably always going on to some extent, must have an effect on the life of plants. We know how valuable light is for plants, and electricity, we know, too, is very like light, though it happens that we cannot see it. Lately, fields of various plants, including the wheat-plant, which is so important for our lives, have been covered, at a little height, with electric wires, so arranged that electricity passes from them into the earth. The wires are placed on poles high enough for any one to walk under them. And it has been proved that the increase in the amount of electricity that passes into the soil, or perhaps the amount that passes into the leaves of the plants, is *enormously* valuable. The plants grow more quickly and strongly; and they produce far more wheat, or potatoes, or whatever the crop may be. Plants, then, can be grown by electricity. Of course, they must have light and air, and food in the soil as well, and it now seems probable that all green plants grow largely by the aid of electricity, which is the reason why they grow so much better when we supply them with more. This discovery is one of the most important ever made about the growth of plants, for it promises that we shall be able to feed, say, twice as many people from a field of corn as we could before. People living on an island, which they cannot make any bigger, and where they cannot grow all the food they need, will see what a matter of importance this is.

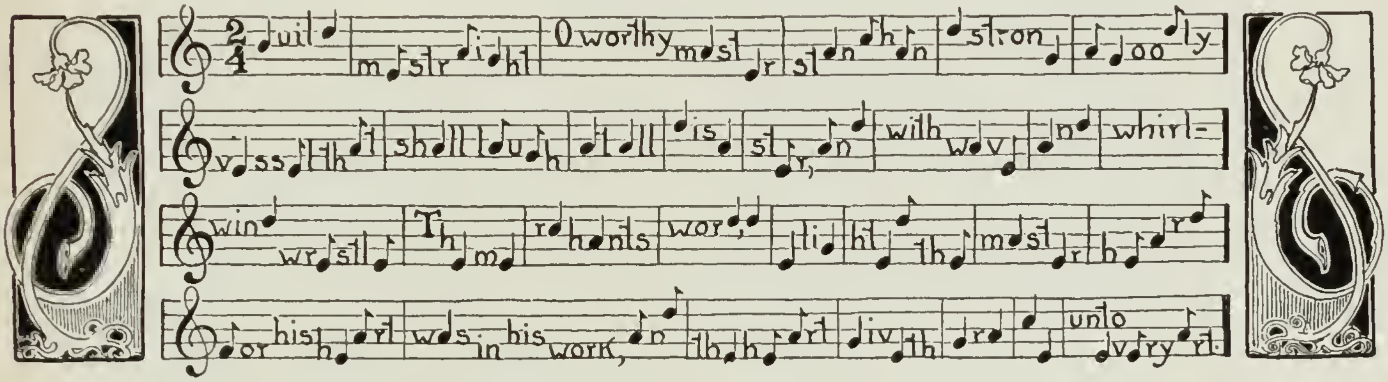
DOES THE EARTH MAKE THE AIR THAT WE BREATHE?

The air that we breathe is part of the earth, and has been so from the earth's beginning. At one time, the whole of the earth must have been gaseous, and what we now call the air is simply the part of the earth that is still gaseous, and, being lighter than the solids or the liquid part of the earth, lies outside these, and forms a thick, unbroken envelope for them both. Any sun or planet that is large enough has an envelope of gas round it. We should not say it *made* this envelope, but that the envelope is the part of it that has remained gaseous.

It would really be just as reasonable to ask: Does the earth make the water that we drink? It is true, however, that the earth makes its own air, in the sense that the composition of the atmosphere is always being changed by the things that happen at the surface of the solid earth, or at the surface of the seas. Gases are passing into the atmosphere from living creatures and from the sea, and other gases are passing from living creatures and the sea to the atmosphere. Every shower of rain alters the composition of the air in some degree, and so does every breath we breathe.

ILLUSTRATED PUZZLES AND CHARADES

MUSICAL PUZZLE


2/4
uil
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O worthy m st r st n h n
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oo ly
v ss Th t sh ll u h
t ll is st n with w v n whirl-
win wr stl Th m r h nts wor
li ht th m st r b r
or his h rt w s in his work, n th h rt iv th r unto v ry r t.

How many can find, in the above lines, two verses from a famous poem by Longfellow?

CHARADES

I

My *first* is a statesman, a pen and a bird;
There are people who worship my *last,* I have heard.
My *whole* sailed away in a ship called the Argo,
And hoped to obtain a much coveted cargo.

II

In a little school-house that stood on a hill
A little old schoolmaster taught with a will.
But over his pupils he had no control;
They said he was crusty and cross and my *whole.*
And the rascals declared it would serve him just right
To play him a practical joke some fine night.
So down to the river they went, and they took
My *first* from his *last* in the dark, muddy brook.
Then they eagerly hurried, yet quiet as a mouse,
Till they came to the little old schoolmaster's house.
They smuggled my *first* in my *last* with great glee,
And chuckled to think how irate he would be.

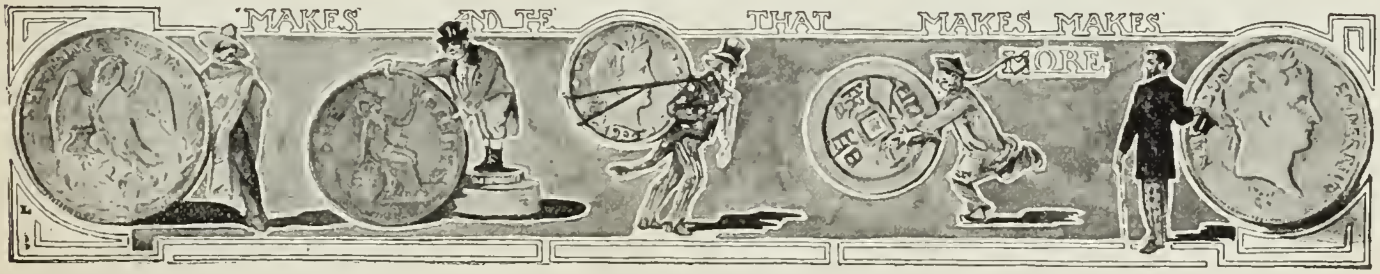
III

Men often strive my *first* to gain
By strength or skill, by speed or worth;
It causes deepest woe and pain,
It causes also joy and mirth.

I watched a tennis-player serve,
And through the air the ball whizzed fast,
But took an unexpected curve;
The umpire said it was my *last.*

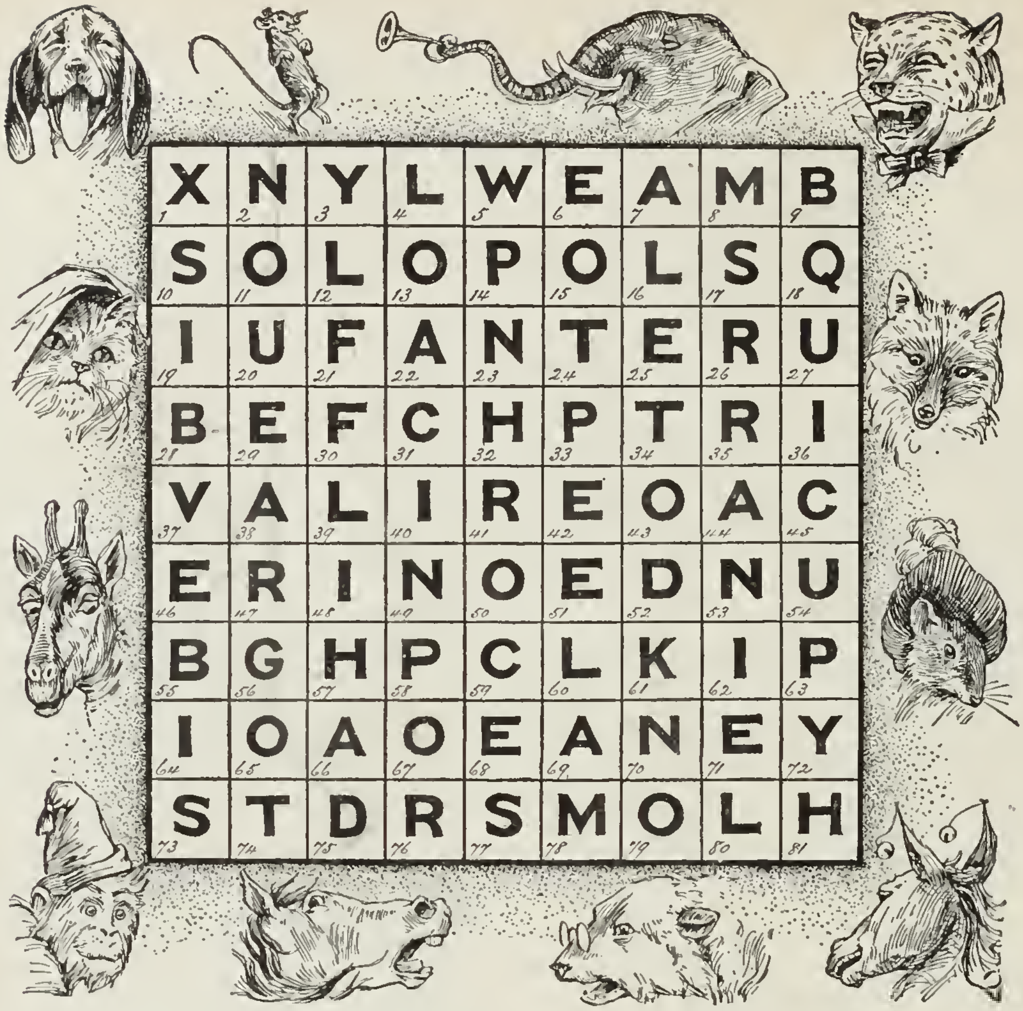
With thoughtful eyes and puzzled brow,
It is my *whole* you 're reading now.

REBUS



The answer to the above rebus is an old saying that should be heeded by spendthrifts.

KING'S MOVE PUZZLE



X 1	N 2	Y 3	L 4	W 5	E 6	A 7	M 8	B 9
S 10	O 11	L 12	O 13	P 14	O 15	L 16	S 17	Q 18
I 19	U 20	F 21	A 22	N 23	T 24	E 25	R 26	U 27
B 28	E 29	F 30	C 31	H 32	P 33	T 34	R 35	I 36
V 37	A 38	L 39	I 40	R 41	E 42	O 43	A 44	C 45
E 46	R 47	I 48	N 49	O 50	E 51	D 52	N 53	U 54
B 55	G 56	H 57	P 58	C 59	L 60	K 61	I 62	P 63
I 64	O 65	A 66	O 67	E 68	A 69	N 70	E 71	Y 72
S 73	T 74	D 75	R 76	S 77	M 78	O 79	L 80	H 81

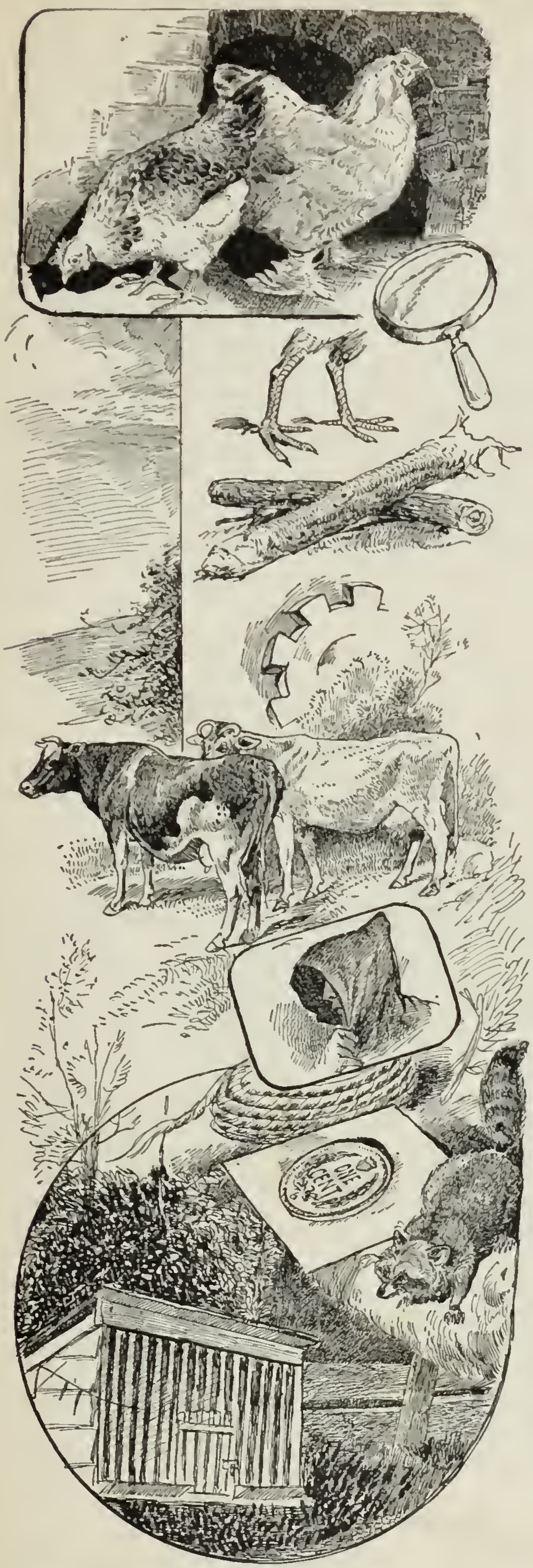
The eighty-one squares in this puzzle contain the names of forty-two animals. They may be spelled out by what is known in chess as the "king's move," namely, one square at a time in any direction. Thus, from the first O on the second line, one could move to X, N, Y, L, F, U, I or S. Thus, dog might be found in the squares 75, 65, 56; and porcupine in 33, 43, 35, 45, 54, 63, 62, 70, and 71.

CONCEALED PROVERB

OH! IT'S NICE TO FLOAT IN AN OPEN BOAT
WITH AN ELDERLY OWL FOR CREW,
IF ONE DOES N'T GET ILL WHEN THE WHITE
SAILS FILL
AND THE WIND WHIPS THE WAVES TILL
THEY BOIL CLEAR THROUGH;
OH! THAT IS THE LIFE FOR THE OWL AND ME.
I BLOWS MY PIPE AND "AYE, AYE!" SAYS HE:
THERE'S NOBODY ROUND BUT JUST WE TWO.
BUT THAT OWL BY HIMSELF IS AS GOOD AS
A CREW.

By taking one word from each of the eight lines of the above verse a proverb may be formed.

METAMORPHOSES



THE problem is to change one given word to another given word, by altering one letter at a time, each alteration making a new word, the number of letters being always the same, and the letters remaining always in the same order. Example: Change LAMP to FIRE in four moves. Answer: lamp, lame, fame, fare, fire.

In the accompanying picture, change HENS to COOP in ten moves. Each change is shown in the illustration.

IV

THOUGH some one spoke this truthful word,
"The pen is mightier than the sword,"
Without my *first,* you 'll all agree,
Of little use the pen would be.

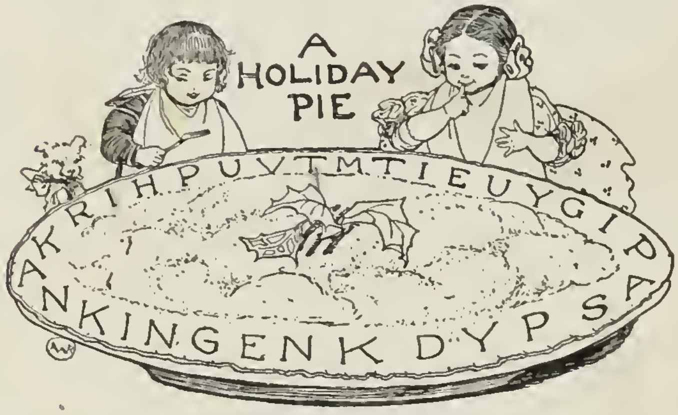
Deep in my *second,* long ago,
Young Mr. Green was said to throw
A victim innocent of wrong,
The hero of a well-known song.
What products of what mighty brains!
What wondrous books my *whole* contains!
What reams of prose and verse! Yet all
Tinged with the bitterness of gall!

V

MY *first,* men call thee wicked, and perhaps they may be right,
Yet I contend thou shouldst be judged according to thy light.

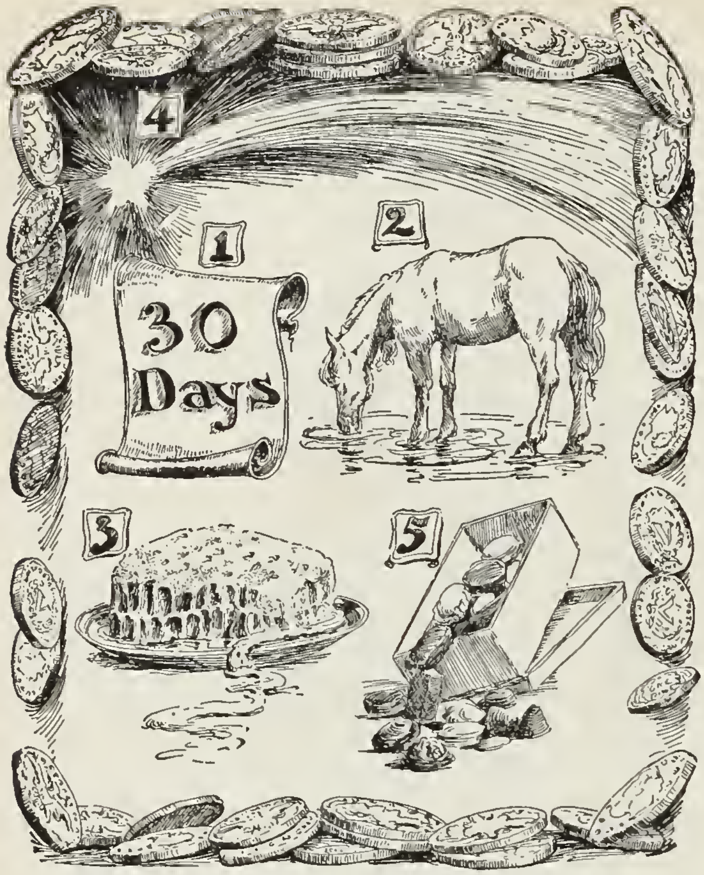
My *last,* thou art a messenger received with joy or dread,—
Frequently driven, very deaf, found in an humble shed.

My *whole,* of upright bearing, and found in many lands,
In order to be seen of men, upon street-corners stands.



BY beginning with a certain letter and going round and round, skipping the same number of letters each time, five words, often heard at a certain season of the year, may be spelled.

DIAGONAL



All the pictured objects may be described by words of equal length. When rightly guessed and written one below another, the diagonal (beginning at the upper, left-hand letter and ending with the lower, right-hand letter) will spell a word often used.

VI

To the grandest of monarchs that ever was seen
My *first* was presented by Sheba's fair queen.

Far, far away back in the ages long past,
According to science, the earth was my *last*.

My *whole* is a creature exceedingly fair,
Addicted to singing and combing her hair.

VII

It was my *whole*, a thunder-storm had burst;
My *last* was fierce, and filled us with my *first*.

VIII

Beneath the Roman Eagle's glory,
Great Cæsar, famed in song and story,
Triumphant banners floating o'er him,
Carried my Roman *first* before him.

In springtime days of sunny weather,
When lads and lasses dance together,
Around the May-pole gaily flying,
They are my *last*, there 's no denying.

A gallant knight and lovely lady
Were sauntering down a pathway shady;
He offered her, with words beguiling,
My *whole*, which she accepted, smiling.

IX

Old Deacon Griggs made money fast;
His greatest virtue was my *last*.
But his son John turned out my *whole*,
Which grieved the deacon's sordid soul;
For hast'ning to my *first*, the son
Disbursed the gold that Griggs had won.

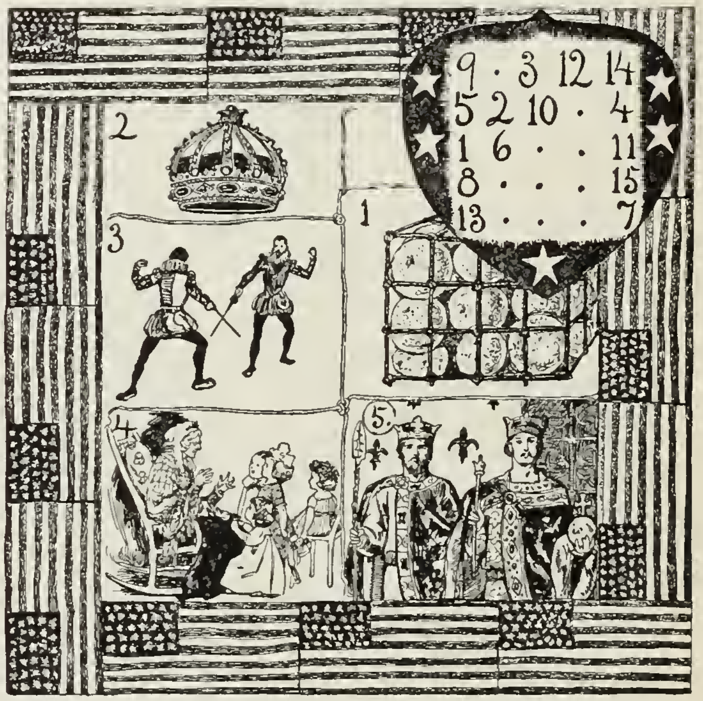
X

A Scotsman and a sailor met
One day upon the shore;
And one was my *first* with a coat of my *last*,
And my *whole* the other wore.

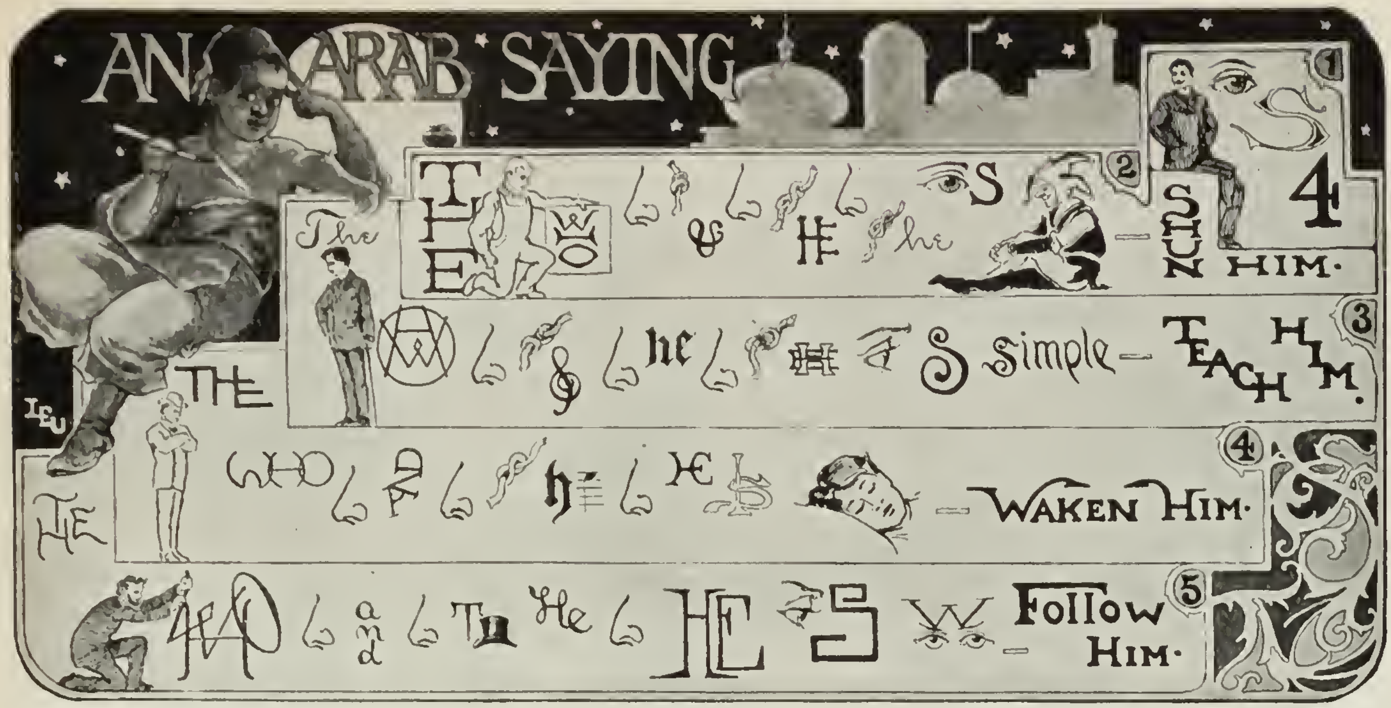
XI

An ancient family of Chaldee
Went from my *first* to Canaan's land.
My *second* I can never see,
But I can hold it in my hand.
My *whole* is found on the ocean's bed,
Though often on pillows he rests his head.

A PATRIOTIC PUZZLE

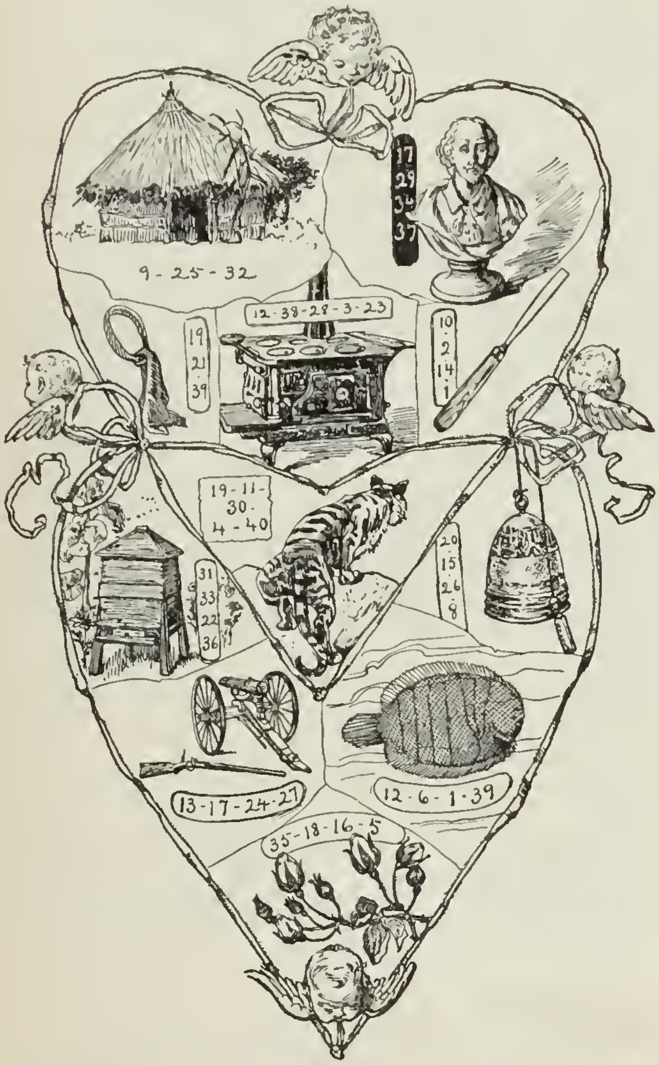


Each of the five little pictures may be described by a word of five letters. When rightly guessed and written one below another, the letters from 1 to 15 will spell the name of an American poet who wrote a famous song.



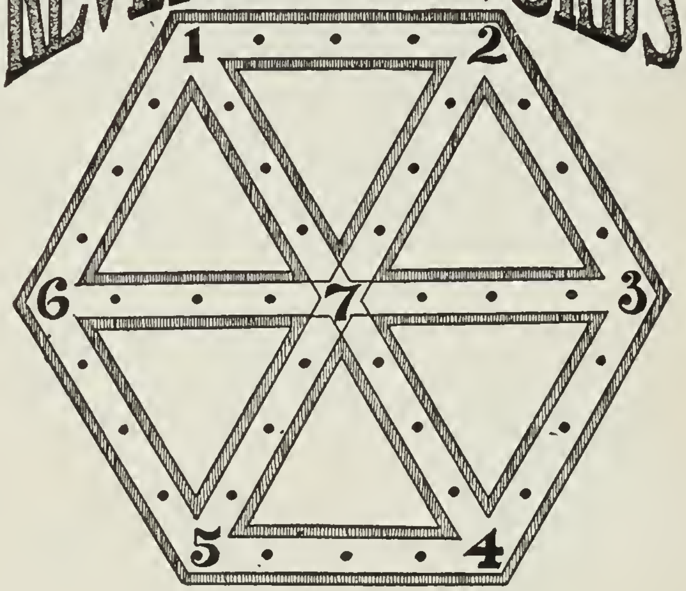
Here is an Arab saying. It begins with the little picture at the right-hand upper corner, marked 1. That reads, "Man is four." How do the four following lines read?

NUMERICAL ENIGMA



In this numerical enigma the words are pictured instead of described. When the eleven objects have been rightly guessed, and the letters set down in proper order, they will spell a quotation from "Twelfth Night."

REVERSIBLE WORDS



From 1 to 2 (five letters), a merrymaking; from 2 to 1, one of the six mechanical powers; from 2 to 3, nooses; from 3 to 2, found in every work-basket; from 3 to 4, a narrow piece of leather; from 4 to 3, portions; from 4 to 5, removes the outer covering; from 5 to 4, to slumber; from 5 to 6, haste; from 6 to 5, great depths; from 6 to 1, to delay; from 1 to 6, fed again; from 1 to 7, fumes; from 7 to 1, beloved by smokers; from 2 to 7, plunders; from 7 to 2, a high seat without a back; from 3 to 7, genders; from 7 to 3, the same; from 4 to 7, harbors; from 7 to 4, a strap; from 5 to 7, checks; from 7 to 5, stains; from 6 to 7, drags; from 7 to 6, turf.

XII

Leaving my *whole* with grief and pain,
Columbus sailed across the main.
He came at last to western lands
And saw the Red Men's savage bands.
They were my *last*, they were my *first*,
Columbus' fears were then dispersed.

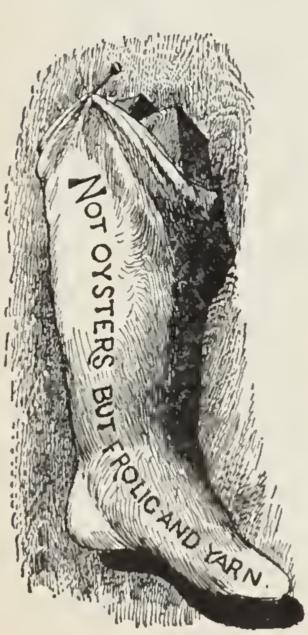
XIII

My *whole* drops from trees.
My *last* is a season,
When as every one sees
My *whole* drops from trees.

My *first* is a breeze,
And that is the reason
My *whole* drops from trees.
My *last* is a season.

XIV

My *first* was ground beneath the oppressor's wheel,
Subjected unto barbarous tyrannies;
With ears cut off, encaged in netted wire
Into a burning fiery furnace thrust.
My *first* take from my *second*, and my *whole*
Remains.
My *second* is a faithful friend.
Gaily with him across the moors I go
From morn to dewy eve.
I went one day
To visit an old man. Beside the fire
He sate. His well-loved pipe, made of my *whole*,
He smoked in calm and undisturbed content.


NOT OYSTERS BUT FROLIC AND YARN.

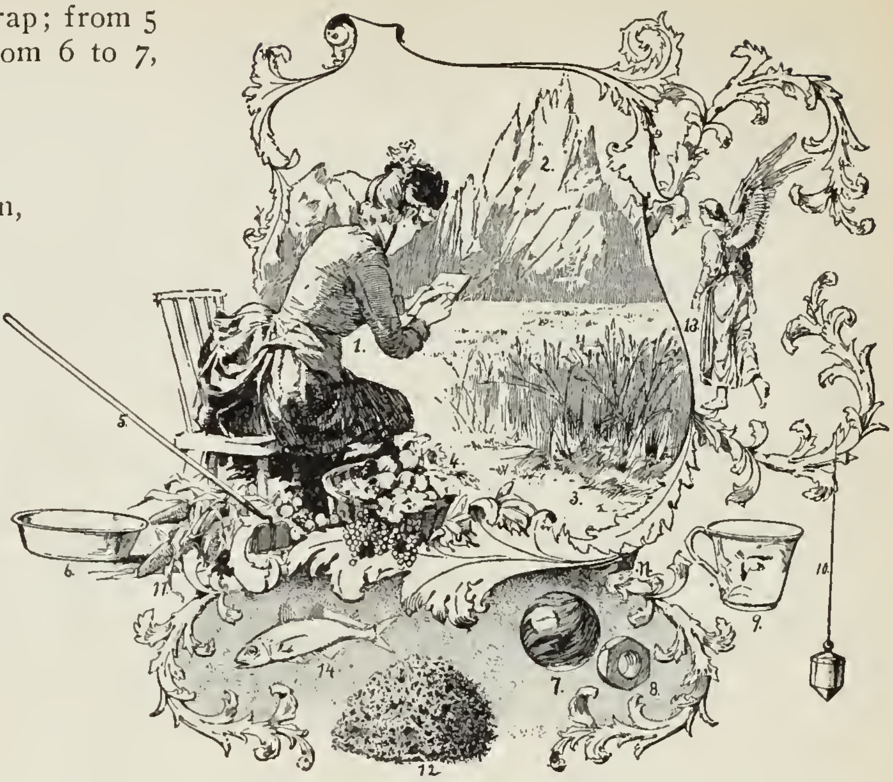
XV

My *total* of the heavens showed that a storm would burst,
So we went into my *second* before it should my *first*.

CONCEALED WORDS

What two objects, common at Christmas-time, are concealed in the accompanying Christmas stocking?

A CAKE PUZZLE



Find the names of fourteen kinds of cake in the accompanying illustration.

XVI

My dogs I love, my horses I adore;
They 're much to me, and yet my *last* is more.
And though my *first* is less, my *whole*, I know,
Has ever been my *last's* unconquered foe.

XVII

In certain realms men have to bring
My *first* to earth before their king;
In others, they are only bound
To make my *second* touch the ground.
My *whole* 's a curious little man—
One of a most amusing clan.

XVIII

We were all alone in the castle,
Sir Harry and my *first;*
We sat by the smold'ring embers,
And idly we conversed.

Sir Harry went to the window
And looked out through my *last*.
" 'T is a biting night outside," quoth he,
"It blows a roaring blast."

It was twelve by the clock in the turret,
I was smoking my last cigar;
My *whole*, on the bridge at midnight,
Was chained to a metal bar.

XIX

In my *first* sweet Peggy rode,
Like my *whole* her fair cheek glowed;
At her feet my heart I 'd cast,
If she 'd only be my *last*.

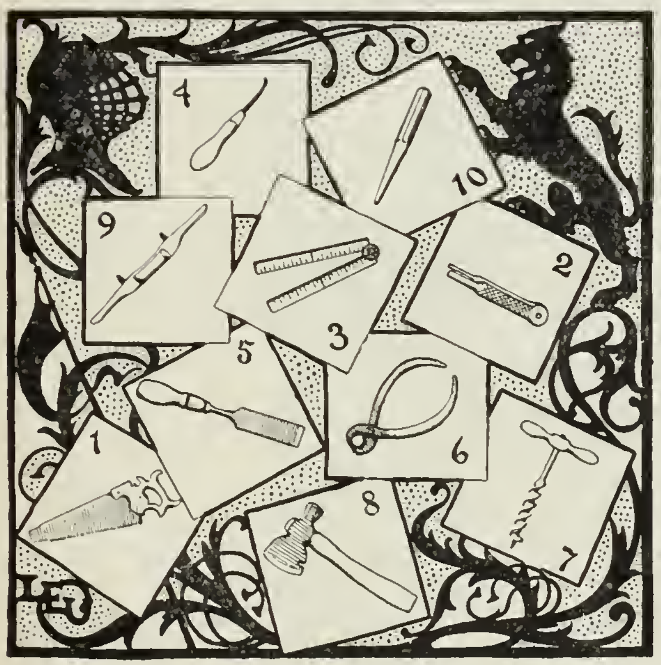
XX

My *first*, of high degree,
Thousands succumb to thee—
In Oriental countries thou art found;
Beneath thy mighty power
Thy fainting victims cower,
Thy greatness brings them prostrate to the ground.

Unhonored and unsung,
My *second* was, when young,
Beheaded by a tyrant's stern decree;
Her home and friends she left,
Her children were bereft,
Yet martyred in a worthy cause was she.

In far Afghanistan,
In China and Japan,
On Greenland's ice and India's coral strands;
My *whole* in mighty hordes,
So history records,
Worship their idols in barbaric bands.

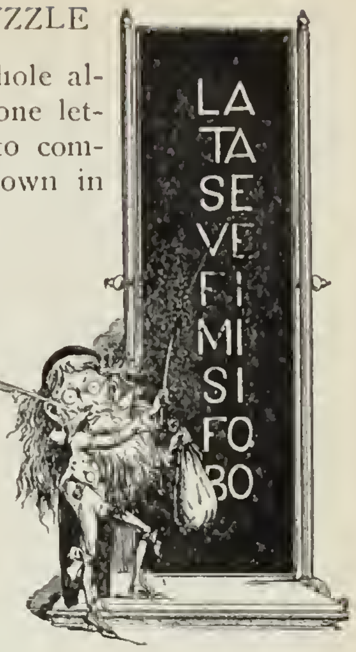
MILITARY ACROSTIC



When the ten tools shown in the above picture have been rightly guessed, and the words (of unequal length) written one below another, one of the rows of letters, reading downward, will spell the name of a very famous English general.

MISSING LETTER PUZZLE

This little man has the whole alphabet in his bag. What one letter must he take from it to complete the nine syllables shown in the picture?



ANSWERS TO ILLUSTRATED PUZZLES AND CHARADES

Musical Puzzle. Eight lines from "The Building of the Ship," beginning:

Build me straight, O worthy master;
Stanch and strong, a goodly vessel
That shall laugh at all disaster
And with wave and whirlwind wrestle.

Rebus. Money makes money, and the money that money makes, makes more money.

King's Move Puzzle. Bison, bear, bull, giraffe, buffalo, pig, goat, stag, dog, tiger, fox, wolf, ox, lynx, squirrel, panther, porcupine, camel, elk, hyena, cat, rat, calf, mole, seal, lion, weasel, boar, otter, antelope, monkey, donkey, elephant, rhinoceros, deer, horse, hare, leopard, ape, lamb, doe and beaver.

Concealed Proverb. It 's an ill wind that blows nobody good.

Metamorphoses. Hens, lens, legs, logs, cogs, cows, cowl, coil, coin, coon, coop.

A Holiday Pie. Begin at the "t" under the word "Pie" and go to the left, skipping three letters each time. In this way may be spelled out "Thanksgiving Day, turkey, pumpkin-pie."

Diagonal. Money. 1. Month. 2. Horse. 3. Honey. 4. Comet. 5. Candy.

A Patriotic Puzzle. From 1 to 15, Francis Scott Key. 1. Crate. 2. Crown. 3. Fight. 4. Story. 5. Kings.

Numerical Enigma. "Love sought is good, but given unsought is better."

Reversible Words. From 1 to 2, revel; 2 to 3, loops; 3 to 4, strap; 4 to 5, peels; 5 to 6, speed; 6 to 1, defer; 1 to 7, rages; 2 to 7, loots; 3 to 7, sexes; 4 to 7, ports; 5 to 7, stops; 6 to 7, draws.

An Arab Saying. Man is four. The man who knows not and knows not he knows not, he is a fool—shun him. The man who knows not and knows he knows not, he is simple—teach him. The man who knows and knows not he knows, he is asleep—waken him. The man who knows and knows that he knows, he is wise—follow him.

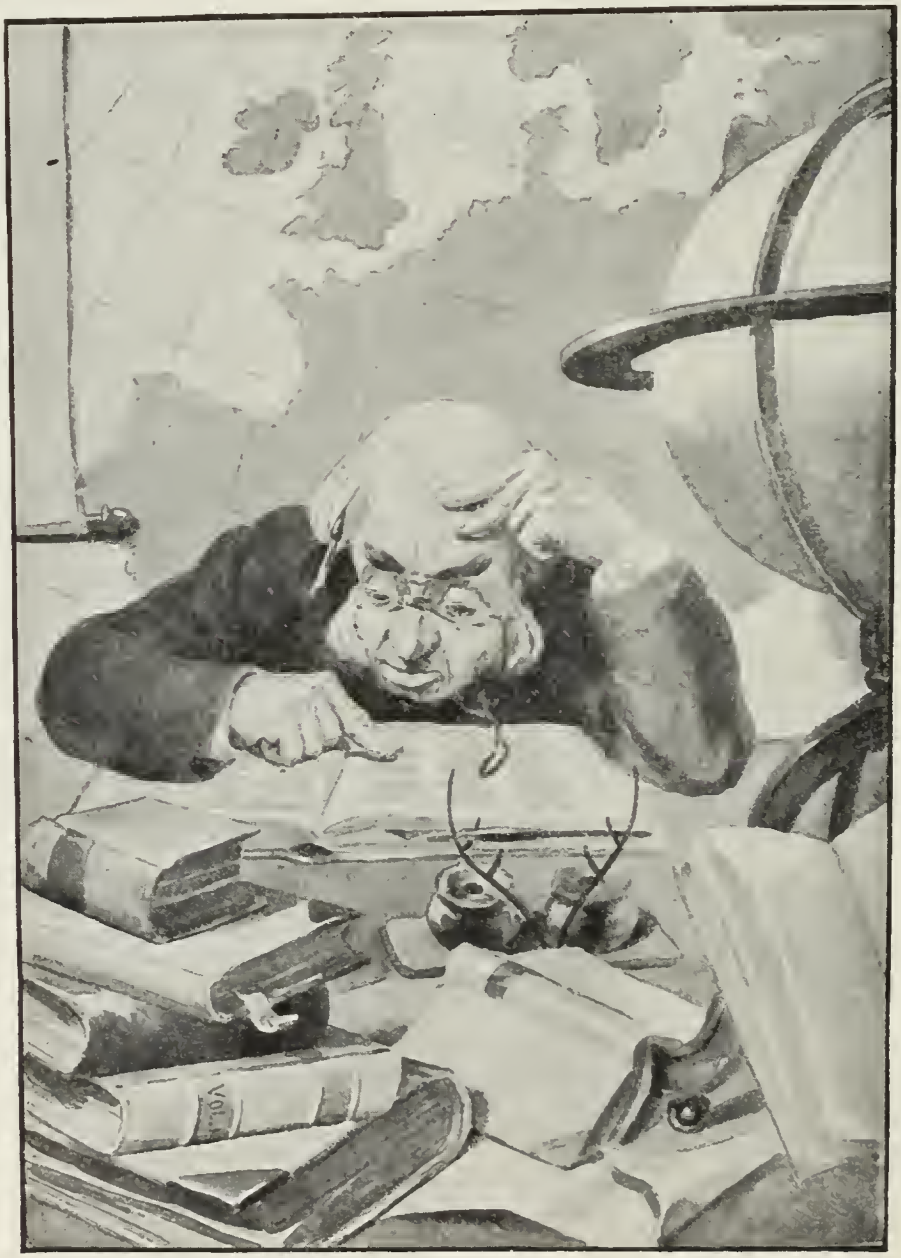
A Cake Puzzle. 1. Lady. 2. Mountain. 3. Wheat. 4. Fruit. 5. Hoe. 6. Pan. 7. Marble. 8. Nut. 9. Cup. 10. Plum. 11. Corn. 12. Sponge. 13. Angel. 14. Fish.

Concealed Words. "Toys" and "Candy."

Military Acrostic. Third row, Wellington. 1. Saw. 2. Tweezers. 3. Rule. 4. Awl. 5. Chisel. 6. Pincers. 7. Auger. 8. Hatchet. 9. Spokeshave. 10. Punch.

Missing Letter Puzzle. The letter X.

Charades. I. Jay-son, Jason. II. Crab-bed. III. Cup-let, couplet. IV. Ink-well. V. Lamp-post. VI. Myrrh, made, mermaid. VII. Awe-gust, August. VIII. Nose-gay. IX. Spend-thrift. X. Tar-tan. XI. Ur-chin. XII. Kind-red. XIII. Wind-fall. XIV. Corn-cob. XV. Pour-tent, portent. XVI. Less-son, lesson. XVII. Brow-knee, brownie. XVIII. Eye-glass. XIX. Car-mine. XX. Heat-hen, heathen.



"IF THE *FIRST* IS A BLACK LIQUID AND THE *LAST* A DEEP EXCAVATION HOLDING WATER, WHAT CAN THE *WHOLE* POSSIBLY BE!"

GAMES FOR LITTLE CHILDREN

SPIN THE PLATE

This is a game which almost any number of children can play.

The players seat themselves in a circle, and each takes the name of some town, or flower, or whatever has been previously agreed upon. One of the party stands in the middle of the circle, with a tin plate, places it upon its edge, and spins it, calling out as he does so the name which one of the players has taken. The person named must jump up and seize the plate before it ceases spinning, but if the player is not very quick the plate will fall to the ground, and he must then pay a forfeit. It is then his turn to spin the plate.

MAGIC MUSIC

One of the players is sent out of the room, and the rest then agree upon some simple task for her to perform, such as moving a chair, touching an ornament, or finding some hidden object. She is then called in and some one begins to play the piano. If the performer plays very loudly the "seeker" knows that she is nowhere near the object she is to search for. When the music is soft, then she knows she is very near, and when the music ceases altogether, she knows that she has found the object she was intended to look for.

PUSS IN THE CORNER

This game is really for five players only, but by a little arrangement six or seven children can take part in the fun.

Four players take their places in the different corners of the room, while the fifth stands in the middle. If a greater number of children wish to play, other parts of the room must be named "corners," so that there is a corner for every player but one. The fun consists in the players in the corners trying to change places without being caught; but they are bound to call "puss, puss," first, and to beckon to the one they wish to change with. As soon as they leave their corners, the player in the center tries to get into one of them.

When the center player succeeds in getting into a corner, the one who has been displaced has to take his place in the middle of the room.

"OUR OLD GRANNIE DOES N'T LIKE TEA"

All the players sit in a row, except one, who sits in front of them and says to each one in turn: "Our old Grannie does n't like T; what can you give her instead?"

Perhaps the first player will answer, "Cocoa," and that will be correct; but if the second player should say "Chocolate," he will have to pay a forfeit, because there is a "T" in chocolate. This is really a catch, as at first every one thinks that "tea" is meant instead of the letter "T." Even after the trick has been found out, it is very easy to make a slip, as the players must answer before "five" is counted; if they cannot, or if they mention an article of food with the letter "T" in it, they must pay a forfeit.

CONSEQUENCES

Each player is provided with half a sheet of note-paper and a pencil. The game begins by writing at the head of the paper the name of some man and a verb to show what he did. Thus: "Mr. Smith met." The written words are then folded over out of sight, and the slip of paper is passed on to the next neighbor, no player, of course, knowing what the one before him has written. Every one now writes the name of a lady, folds the paper and passes it on again.

This time all write down what they think was said or done by the persons whose names are hidden, and, having folded the slip, pass it on, when every one adds the words, "and the consequences were"—whatever they like to write down.

This being done, the papers are collected and some one reads out the slips. The consequences of these mixed-up tales are generally very funny.

THE BAG OF LUCK

The bag of luck is a decorated paper bag suspended in a doorway at a convenient height; the children, blindfolded, are given three trials to break it with pretty ribbon-wound wands provided for the purpose. These sticks are given afterward as souvenirs of the evening. The child who succeeds in making the first hole in the bag is entitled to a prize, but all share its contents. It is usually filled with confectionery, but flowers may be substituted when candy is considered objectionable. Sometimes, by way of a joke, the bag may be filled with beans, or even with flour!

THE BLINDMAN'S BREAKFAST

Before beginning to play this game, spread a table-cloth on a rather broad table. This being done, two players are blindfolded and seated opposite to each other, just within arm's reach. A soda-cracker is then given to each, and they proceed to feed one another as best they can. It makes it even funnier if the crackers are finely crumbed and the two who are blindfolded feed one another with cracker-crumbs in spoons.

"I APPRENTICED MY SON"

The best way of describing this game is to give an illustration of how it is played. The first player thinks of "Artichoke," and commences. "I apprenticed my son to a grocer and the first thing he sold was an A."

2d player: "Apple?"—"No."
3d player: "Almonds?"—"No."
4th player: "Asparagus?"—"No."
5th player: "Artichoke?"—"Yes."

The last player, having guessed correctly, may now apprentice his son. No player is allowed more than one guess.

"ANIMAL, VEGETABLE, OR MINERAL?"

This is a capital game for a large party, for it is both instructive and amusing. One player is selected who has to guess what word or sentence the remainder of the company has chosen. He goes out of the room, and when the subject has been decided upon, returns and asks a question of each of the company in turn. The answer must be either "Yes" or "No," and in no case should more words be used, under penalty of paying a forfeit. The first important point to be found out is whether the subject is "Animal," "Vegetable," or "Mineral." Supposing, for instance, the subject chosen is a cat which is sleeping in the room by the fire, the questions and answers might be like the following: "Is the subject chosen an animal?" "Yes." "Wild animal?" "No." "Domestic animal?" "Yes." "Common?" "Yes." "Are there many to be seen in this town?" "Yes." "Have you seen many to-day?" "Yes." "In this house?" "No." "Have you seen many in the road?" "Yes." "Do they draw carts?" "No." "Are they used for working purposes?" "No." "Is the subject a pet?" "Yes." "Have they one in the house?" "Yes." "In this room?" "Yes." "Is it lying in front of the fire at the present time?" "Yes." "Is the subject you all thought of the cat lying in front of the fire in this room?" "Yes." The subject having been guessed, another one is chosen and the game proceeds.

THE QUICK TRAIN

All the players sit round the room in a large circle, and one, who is blindfold, stands in the middle. Each player takes the name of a city, and the leading player makes a list of these, from which he calls out now and then, thus: "The train is going from Boston to New York," choosing "cities" on opposite sides of the circle. "Boston" and "New York" jump up and slip across to each other's seat, the blindman doing his best to catch one of them as they pass. When several cities have changed places, and the blindman has failed to make a prisoner, the leader cries out, "Quick Train," then all must jump up and cross over to opposite sides. In the hurry and confusion the blindman is sure to catch some one, who takes his place while he becomes one of the cities.

THE DWARF

This is a most amusing game if well carried out. The two performers must be hidden behind two curtains in front of which a table has been placed.

One of the performers slips his hands into a child's socks and little shoes. He must then disguise his face, by putting on a false mustache, sticking pieces of black court-plaster over one or two of his teeth, which will make it appear as though he has lost several teeth. This, with a turban on his head, will prove a very fair disguise. The second performer must now stand behind the first and pass his arms round him, so that the second performer's hands may appear like the hands of the dwarf, while the first performer's hands make his feet. The figure must, of course, be carefully dressed, and the body of the second performer hidden behind the curtains.

The front player now puts his slippered hands upon the table and begins to keep time, while the other performer follows suit with his hands.

The dwarf can be used either to tell fortunes, make jokes, or ask riddles, and if the performers act their parts well, it will prove a very amusing performance.

FRENCH AND ENGLISH

A space is ruled off at each end of the slate. These are called "fields," one being French and the other English. They are then filled with soldiers—that is, a number of plainly marked small circles. The battle begins by one of the players drawing his slate pencil rapidly from his own field right through that of the enemy. The number of soldiers that this line crosses are said to be killed. The second player then "fires his gun" in turn, and the one whose soldiers are all killed first loses the game. When drawing the line, each player should close his eyes.

SPELLING-BEE

This is a game for good spellers. The first player begins a word, which he does not tell, starting with A, the second player adds a letter, and all the other players do so in turn. The player ending a word drops out or pays a forfeit.

Suppose the first player says T, the second R, the third E. Now comes the critical moment; if the fourth player says E, he finishes a word—tree. But if he is clever he will say A, and then the fifth player may, perhaps, say T. But he need not do so, as he can say S, leaving the next player to say U. Then the next might say R, and the next E, which would end the word Treasure. If the eighth player is clever, however, he will say I instead of E, so that the tenth player must make the word Treasuring or Treasuries.

The great point of the game is to keep a word up as long as possible, but, of course, all words must end. No proper names are allowed, and it is best not to count words of three letters. The game should be played through from A to Z, the first word beginning with A, the second with B, and so on.

SALLY WATERS

This game can be played by any number of children. A ring is formed in which all join, with the exception of one little girl who kneels in the center of the ring. The children then dance round her, singing the following verses:

"Little Sally Waters, sitting in the sun,
Crying and weeping for a young man.
Rise, Sally, rise, wipe off your eyes;
Fly to the East and fly to the West,
Fly to the very one that you love best."

When they come to the words "Rise, Sally, rise," the child in the center rises and chooses another from the ring. The next two lines are then sung, and the two children in the ring dance round and round. Sally then joins the ring, the second child remaining in the circle, and the game is continued as before till all the players have acted the part of Sally.

DROP THE HANDKERCHIEF

A ring is formed by the players joining hands, while one child, who is to "drop the handkerchief," is left outside. He walks round the ring, touching each one with the handkerchief, saying the following words:

"I wrote a letter to my love,
But on my way I dropped it;
A little child picked it up
And put it in his pocket.
It was n't you; it was n't you;
It was n't you—but it *was you!*"

When he says, "It *was you,*" he must drop the handkerchief behind one of the players, who picks it up and chases him round the ring, outside and under the joined hands, till he can touch him with the handkerchief. As soon as this happens, the first player joins the ring, while it is now the turn of the second to "drop the handkerchief."

THE SCHOOLMASTER

This is always a favorite game. One of the players is chosen schoolmaster, and the others, ranged in order in front of him, form the class. The master may then examine the class in any branch of learning. Supposing him to choose geography, he must begin with the pupil at the head of the class, and ask for the name of a country or town beginning with A. If the pupil does not reply correctly before the master has counted ten, he asks the next pupil, who, if he answers rightly—say, for instance, "America," or "Amsterdam"—in time, goes to the head of the class. The schoolmaster may go on in this way through the alphabet, either regularly or at random, as he likes. Any subject—names of kings, queens, poets, soldiers, etc.—may be chosen. The questions and answers must follow as quickly as possible. Whoever fails to answer in time pays a forfeit.

WINKS

A CIRCLE is formed of chairs, one only of which is unoccupied. Behind each chair, including the vacant one, stands a player whose duty it is to prevent the person sitting in front from leaving his chair, though no effort must be made to check him until he shows some intention of escaping. The guardian of the vacant seat looks round the ring and winks to some one to come and occupy it. The player thus called must be very alert, or the one behind his chair will clutch him before he can get away. One touch is enough. If successful, the chair left becomes the vacant one, and the player behind it must lose no time in trying to get another tenant by a wink or a nod at some one else. The faster the changes take place the greater the fun, but the guardians behind the chairs must, of course, be as quick as they can to avoid losing their charges.

HUNT THE SLIPPER

THE players seat themselves in a circle on the floor, having chosen one of their number to remain outside the circle. The children seated on the floor are supposed to be cobblers, and the one outside is the customer who has brought his shoe to be mended. He hands it to one of them, saying:

"Cobbler, cobbler, mend my shoe;
Get it done by half-past two."

The cobblers pass the shoe round to each other as quickly as they can, taking care that the customer does not see which of them has it. When the customer comes to fetch it he is told that it is not ready. He pretends to get angry and says he will take it as it is. He must then try to find it, and the cobbler who has it must try to pass it to his neighbor without its being seen by the customer. The person upon whom the shoe is found must become the customer, while the customer takes his place in the circle on the floor.

THE TRAVELER'S ALPHABET

THE players sit in a row and the first begins by saying, "I am going on a journey to Athens," or any place beginning with A. The one sitting next asks, "What will you do there?" The verbs, adjectives, and nouns used in the reply must all begin with A; as, "Amuse Ailing Authors with Anecdotes." If the player answers correctly, it is the next player's turn; he says, perhaps: "I am going to Boston." "What to do there?" "Bring Back Beans and Brown Bread." A third says: "I am going to Constantinople." "What to do there?" "Carry Contented Cats." Any one who makes a mistake must pay a forfeit.

CAT AND MOUSE

ALL the players join hands and form a ring. A little girl—the mouse—stands in the center; outside the circle prowls a boy—the cat. They dance round and round rapidly, raising their arms at intervals. Watching his chance, the cat tries to spring into the circle at one side; the mouse dashes out at the other. The children, always sympathizing with the mouse, aid her efforts and impede the cat's. When the latter gets into the circle, they lower their arms to keep him prisoner. He goes around meekly, crying "Mew, mew," while they all dance gaily around him. With a sudden "Miaow," out he dashes through a weak place he has found in the chain of hands. He at once pursues the mouse, who runs for safety into the ring. If the cat is so near as to follow the mouse into the ring before he can be prevented, she pays a forfeit; also when caught outside the circle. If the cat is unsuccessful, he must pay the forfeit. Two other players are then selected by cat and mouse to succeed them. The forfeits are imposed by the hostess, and are paid when the game is over. These forfeits can be made very amusing.

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INTERESTING QUESTIONS AND ANSWERS

WHAT IS THE FORCE IN LIGHTNING THAT KILLS A MAN SO QUICKLY?

We use the word lightning to mean two distinct things—first, the light that is seen when electricity passes strongly from a cloud to the earth; and, secondly, the electricity which causes that light. The light itself is quite harmless. It may be seen at a great distance from the place where the lightning really passed, but whether it is seen from afar, or close at hand in a blinding flash, it cannot hurt any one.

But the electricity itself is very different. If this strikes the ground close beside a man, it will do him no harm; but, if it actually passes to the earth through his body, it may kill him. It does this very suddenly, as a rule, by affecting the brain and the nerves that run from it to the heart. As we know, two of these nerves, one on each side of the body, are capable of stopping the heart altogether, if they act powerfully. The electricity, in passing, stimulates, or excites, those nerves, so that they stop the heart, and the person dies from shock.

WHAT IS IT LIKE ABOVE THE CLOUDS?

When we go up in a balloon above the clouds, or when we go so high up a mountain that we leave the clouds beneath us, we find exactly what we expect. The air is very bright and clear, and the sun—or the stars, if it is night—are seen very distinctly. Both sides of a cloud are very much the same, and when we look down on the clouds from above, they appear just the same as bright clouds appear from the earth. They are, of course, always bright clouds that we see from above, because we are looking at the side of them upon which the sun is shining.

Some astronomers who did this found that, at a height of several thousand feet, the balloon soared clear of fog, and came out into brilliant sunshine. They saw the fog beneath them, but of course, they saw it as a quite bright thing, as a great deal of the sunlight was stopped by it, and reflected back from its surface to their eyes. When there is no fog, but only clouds scattered about, and we go up above them in a balloon, we get glimpses of the earth between them as we look down; and those who have seen this say that it is a very wonderful sight. Of course, they do not see the earth spinning underneath them, because the air spins round with the earth, and the balloon spins round with the air.

WHY DOES THE MOON NOT SHINE BY DAY?

The moon and the stars *do* shine by day, though we cannot often see them! And the sun shines by night, only we cannot see it. We are unable to see the sun shining at night, because we are on the opposite side of the earth to it. We cannot see the moon or stars shining by day, because the sun is so bright that the stars are *put out* altogether, unless the sun is eclipsed, when they are seen to shine; but it is not so bright as to prevent us from seeing the moon altogether. Of course, there are times in the month when the moon rises at sunset; but when the moon rises in the daytime it can often be seen; and, if it is seen, it is shining, though apparently it is not shining so brightly as it does in the darkness of night.

WHY DO SO MANY PIPES BURST DURING FROSTY WEATHER?

We know already that water has a great peculiarity in the way it behaves when it is cooled. The rule is, that a thing contracts and shrinks as it cools, and if water is cooled down to within a few degrees of its freezing-point, it obeys this rule. But if it is cooled still farther, it then begins to expand, until it freezes and turns into ice. So ice occupies more space than the liquid water which is nearly cold enough to turn into ice, but not quite. When the frost comes, it often freezes the water in the pipes in our houses, and, as this means that the water, in the form of ice, occupies more space than it did before it was frozen, it cracks the pipes.

The water, when it freezes, is stretched, so to speak, to form ice, and bursts the pipe that tries to prevent it from stretching or expanding itself. This gives us some idea of the power of its expansion. Of course, as long as the frost continues, we do not notice any bursting of our water-pipes, but, as soon as the thaw comes, the ice in the pipes melts, the water runs out, and causes damage. Many people therefore think that the thaw bursts the pipes, but, as we see, they are wrong. The frost bursts the pipes, and the thaw only shows us that they are burst.

WHAT IS THE CAUSE OF QUICKSANDS?

Quick is really an extremely old word which means living, or moving. These words, living and moving, were thought to mean practically the same thing long ago. A quicksand is a bank of sand in water; perhaps in the sea, or a lake, or a river, or we may even meet a quicksand when we dig in the earth. The sand moves with the water which is around or in it, and thus a person or a boat that is caught in such a sand may be gradually drawn down into it, as the water, and some of the sand with it, sinks.

The famous Goodwin Sands, off the coast of Kent, England, were once an island, and may be quite firm and dry in parts for some hours, but when covered by the sea they shift and become quicksands. In this state they are terribly dangerous to vessels that get caught upon them. The weight of the moving sand is tremendous and irresistible. We must not think of it as sticky. It is simply the weight and the movement of it that gives it its terrible power. Some 200 years ago thirteen warships were lost in one night by the power of these treacherous quicksands.

HOW CAN DOCTORS TELL OUR TEMPERATURE BY FEELING OUR PULSE?

The rate at which the pulse beats and the height of the temperature in the body have a distinct connection with each other, and go more or less together, so that when the doctor counts the pulse rate, and finds that it is just the rate it should be, he expects also to find the temperature quite usual. If, however, he finds that the pulse is twice as rapid as usual, he will also probably find that the temperature is much higher than normal, because the thing that causes the one to become rapid causes the other to go up. Thus, in all cases of fever, where there is some poisonous substance in the body, this substance causes the heart to beat quickly, and the pulse to become rapid, and it also causes a disturbance in that part of the brain controlling the temperature, so that both the pulse and the temperature are thrown out of gear.

WHY ARE SOME DISEASES INFECTIOUS AND NOT OTHERS?

If we had asked this question a hundred years ago, not even the wisest men could have answered it; but we know now that what we call infection is due to the presence of a vast number of very tiny living cells called germs, or microbes, or bacteria. These little creatures are so small that it requires very high magnifying powers in a microscope to see them, but it is by their action on the living tissues of plants and animals that many diseases are produced. These germs are so small, and so light, that they can be carried about in the air and breathed out from our lungs, so that they may contaminate the atmosphere or our food, and so spread disease whenever they go. That is what is meant by carrying infection. Thus the germs which caused typhoid fever or diphtheria often get into a milk supply or a water supply, and so cause an epidemic among all the people who use that source of water or milk.

DOES IRON OR STEEL GET TIRED?

When we speak of anything getting tired, we naturally think of a living creature, such as ourselves. We know that we, when we are not tired, can do certain things, but when we are tired, some change has occurred inside our bodies that prevents us from doing those things. The proper word for this state is fatigue. Now, if we take a piece of steel like a razor, which can do certain things, such as cut very sharply, and if we overwork it—as we should say if we were talking of a horse—we may find that it will not cut as it used to do, however carefully we prepare its edge. Something has happened to it which prevents it from doing what it was able to do before. We are quite entitled to call this "getting tired," as we do in the very similar case of ourselves.

The fatigue of metals, as it is called, is now a recognized fact, to the study of which at least one well-known student has devoted much of his life. It may be of very great importance at times in the use of tools and machinery, as any one may guess who finds that his razor needs a rest. But the fatigue of metals is also very interesting in another way, especially when we begin to learn how it depends upon changes in the way in which the molecules of the steel are joined to each other. For it may be that, if we could learn fully about the causes of tiredness and the cures of tiredness in razors, and things like that, we might better understand fatigue in ourselves, how to prevent it and how to cure it.

WHY DOES THUNDER TURN MILK SOUR?

Thunder, we know, is a disturbance of the air which we hear as noise, and is made by the passage of electricity, which we call lightning, through the air. This noise in the air does not turn milk sour, so when we think what we really mean by thunder, we see that the question has not been put quite in the right way. All the same, we know that, at times when it thunders, milk very quickly turns sour; and though we see, of course, that the thunder does not turn the milk sour, we must find out what it is that does. The answer is that there is something in the state of the air in thundery weather which affects the milk, and this it does whether we happen to hear thunder or not. The air in thundery weather is charged with electricity. It is also, as a rule, very moist and very warm. These three conditions, especially the presence of the electricity and the warmth, greatly favor what goes on when milk turns sour. And that is why milk keeps such a short time in thundery weather.

DO WE ALWAYS WAKE WHEN WE HAVE HAD AS MUCH SLEEP AS WE WANT?

This is an extremely important question, because the answer to it must decide one of the most essential points in taking care of children.

People who really know—because they have given their lives to studying the subject—are certain that a child will wake when its brain has had all the sleep it needs. The waking is the proper fruit of the sleep. A child could not sleep too long, because directly sleep has done its work the brain must wake; that is what sleep is for. On the other hand, the slightest noise may awaken children before they have had their sleep out, and then grown-up people call them cross and naughty, and say they have got out of bed the wrong side, and all that sort of nonsense. It is only a few children that get all the sleep that Nature asks for them, and it is believed that a large number of these children afterward become the leaders of their generation.

WHAT MAKES THE FIRELIGHT DANCE?

If coal were a simple thing, such as pure carbon, and if it were evenly supplied with a steady draught of air, then the firelight would not dance, but would be quite steady. It dances as it does because the processes of burning go on so very irregularly in the fire. For one thing, the supply of air is not quite constant, for the draught up the chimney is considerably affected by the movements of the wind at the top of the chimney. This, of course, must affect the flames of the fire and make them dance.

But that is not all. In coal there is imprisoned a great quantity of gases of various kinds, all of which can be burnt. As the coal breaks up in the fire, these gases escape, here and there, and it is when they burn that they make the beautiful flames of various colors that dance, and so throw a dancing light into the room.

If we burn coal from which the coal-gas has been removed—coke, as we call it—we get a very hot fire, but one without flame or with very little flame, because we are practically burning nothing but the solid carbon itself. In an ordinary fire a certain amount of the gases and a great deal of the carbon itself go up the chimney unburnt, which is, of course, a great waste, to say nothing more. That is part of the price we have to pay for our pretty fires.

WHY ARE THERE TWO TIDES A DAY?

This is a very puzzling question, to which very few people know the answer. The earth only spins round once in a day, and the moon pulls the water up toward itself on the side of the earth next the moon, making what we call high tide. Any one would think, then, that there must be only one high tide a day. But the moon not only pulls up and heaps up toward itself the water on the side of the earth that is next it at any given moment; it also pulls the earth toward itself away from the water on the other side of the earth, the side farthest from the moon.

The moon attracts the earth more powerfully than the water on the far side of the earth, since that water is farther away from the moon. So when it is high tide anywhere, it is also high tide on the other side of the earth. This must mean that we get two high tides in twenty-four hours.

The first of them, perhaps, is due to the moon heaping up the water on the side of the earth next it—the side of the earth where we are. But twelve hours later the earth has spun round so that we are on the side away from the moon, and now the moon is pulling the earth toward itself more strongly than it is pulling the water, so the water where we are is heaped up again, and that, of course, makes the *second* high tide we have in the twenty-four hours.

WHAT MAKES A LEAD PENCIL WRITE?

If a "lead" pencil were made of lead, or almost any other metal, it would not write. Nearly all metals are too hard to rub away against paper sufficiently for us to notice any marks; and there are no metals whose color would show well against paper. A "lead" pencil is made of a vast number of tiny crystals of carbon. This form of carbon is called graphite, from the Greek word for writing. The crystals are small, and of such a shape that they can easily be rubbed away from each other.

If there were no such thing as friction, the pencil would not write. The power of friction, or rubbing, depends upon the force with which the rubbing surfaces are pressed against each other; so the firmer and harder we press with our pencil, the more graphite is rubbed down by friction on to the page to record the track of our "lead" pencil.

WHY DOES THE LIGHT GIVE LIGHT?

This sounds at first as if it were rather a foolish question, but it is really a very wise one. We know that what we call light is a wave-motion in the ether, just as we know that what we call sound is a wave-motion of another kind in the air; but there still remains the question for us to ask and answer if we can—Why does the one kind of wave-motion produce in our brain the effect we call light, and the other kind of wave-motion the effect we call sound? Why should not the air waves produce the effect of light and the ether waves produce the effect of sound?

We can only answer this by saying that the brain is so made. We can imagine, as a famous student of the mind—Professor James—has said, that the nerves from the eye might run to the hearing center of the brain, and the nerves from the ear to the vision center; or we might imagine that when we went to a concert we should see the music and hear the movements of the conductor and the players. This is simply another way of saying that what we call light and sound are the consequences of the behavior of those parts of our brain which correspond to them.

It is extremely interesting that in some people there are what are called *associated sensation*. In these cases, when one part of the brain is excited, as by a sound, another part—the part that sees—is excited also. In such cases we may say that a sound gives a light. Such people, when they hear the sound of a trombone, will at the same time see a crimson color; or when they hear the sound of another kind of musical instrument they may see a blue color. These cases seem very extraordinary, but they really do happen.

WHAT DO THE FISHES FEED ON?

We all know that the big fishes feed on the little fishes, but the little fishes must feed on something, and as it is very important that there shall be enough fishes for us to eat, it is very important to know what it is that the smallest fishes feed on.

Now, we know that, on the land, plants are the producers and animals are the consumers; the same is true of the sea, which has its pastures, just as the land has. The sea contains vast quantities of humble plants together with humble kinds of animals, which feed on the plants, and these, between them, furnish the food for the smaller fishes.

The huge masses of tiny vegetables and animals floating in the sea have the special name given to them of *plankton*, and it is this plankton that the smaller fishes and the youngest fishes feed on. It seems to be just at the time of year, in the spring, when the plankton is very abundant, and of a very suitable kind, that the small fry of most of our fishes are produced. Later in the year the plankton changes, and seems just to suit the young fishes when they have grown.

It seems to be clear now, also, that the action of light falling upon the sea has the same effect as when it falls upon the plants of the land. Much of the vegetable life that goes to make up this plankton has chlorophyll in it, or something which is a variety of chlorophyll—the coloring matter of green leaves—and by virtue of this it has the power of feeding on the gases dissolved in sea-water, just as land plants feed on air.

WHAT IS A SPONGE?

Every sponge was once alive. The best way of putting the answer to this question, perhaps, is to say that a sponge is the skeleton of a living creature. By skeleton we simply mean the supporting framework of a body. The skeleton of any of the higher kinds of animals is made of bones, and a sponge, of course, is not made of bones nor of bony material, but it is a skeleton nevertheless.

The creatures which make sponges and live in them are of a very humble kind, and inhabit sea-water; they are far lower in the scale of animal life even than worms or oysters or star-fishes. We must not think of the sponge as the skeleton of a single animal; as a matter of fact, it is made by a colony of very simple creatures which live and work together, so to speak. Instead of being separate from each other and swimming about, they make a colony. As their numbers increase, so the sponges they live in increase in size.

The material of which sponges are made is all derived by the creatures from the sea-water in which they live. There is only one kind of sponge that is of much use to us—that which forms a more or less soft skeleton. But other kinds of sponges take other materials out of the sea-water and make a skeleton out of them. Thus, some sponges are quite hard and stony, being derived from the salts of silicon which are in sea-water; and others have a more chalky kind of structure.

In every one of these cases the great marvel is the chemical power of the tiny animals which pick out from the various salts dissolved in sea-water just those which they require, and then build them up into the wonderful thing which we call a sponge.

HOW DOES A SPONGE HOLD WATER?

The behavior of a sponge with water is similar to that of a lump of sugar. It is not easy to understand so long as we study a complicated thing like a sponge or a lump of sugar, but we get the key to it if we study what is really a simpler case of the same thing, and that is the behavior of a fine glass tube. Any kind of tube will do, but a glass one is convenient because we can see what is happening inside it; the finer the tube the more clearly shall we see what happens. A very fine tube is rather like a hair, and so this subject which we are studying is called *capillarity,* from the Latin word for a hair. If we take such a tube and dip it into water, we shall find that, without our sucking the tube, the water runs up inside it to a higher level than outside; and the more hair-like the tube the higher the water will run.

Other fluids, however, will not behave in the same way as water. Mercury, for instance, will be pressed down by the tube, and will stand at a lower level inside it than outside. All we can say is that the surface of the water catches on to the side of the tube and creeps up it a little way.

Now, a sponge or a lump of sugar is really a very complicated system of little irregular tubes, and water behaves with regard to them just as it does with regard to a simple single glass tube. On the other hand, mercury will not run up at all either into a lump of sugar or into a sponge. The rising of the water in the tube, or the sugar, or the sponge, has nothing whatever to do with the atmospheric pressure, and is therefore quite a different matter from its rising in a tube when the end of the tube is sucked by any one.

WHERE ARE THE CLOUDS WHEN THE SKY IS QUITE CLEAR?

Clouds, as we know, are made of water, and water can exist in the air in many different forms. When it forms a cloud, it is really in the form of liquid drops, like the collection of drops that forms a cloud from our breath on a frosty day.

The water that formed the clouds is still in the sky when it is cloudless. What has happened, however, is that, partly owing to the warmth of the sun, and partly, no doubt, to electrical conditions in the upper air, the air is capable of holding all the water in it in gaseous form.

This gaseous water, or water-vapor, is just as transparent as air itself; indeed, it is much better for us to regard water-vapor as one of the things that make up the air, just as much as oxygen or nitrogen. It is difficult for us to realize, perhaps, when we look up at the sky on a cloudless day, that we are looking through water, but we are certainly doing so just as if we had our eyes open under water and were looking up. If it were not for the water that forms part of the air, we should be utterly scorched by the heat of the sun. As it is, however, most of the sun's heat is caught by the water-vapor, which is very opaque to heat, though it is very transparent to light.

WHY ARE SOME THINGS GOOD FOR GROWN-UPS AND NOT FOR CHILDREN?

Perhaps the real truth of the matter is that grown-up people and children do not differ from each other so much, after all, and the things which are really bad for children are not very good for grown-up people; but it is certainly true that things which would injure children very much may not hurt grown-up people.

There are three reasons for this. One is that, as children have very small bodies, it naturally takes a much less quantity of harmful things to hurt them. Another reason is that the body has great power of learning to protect itself against harmful things, and so in many cases grown-up people are able to take these things, such as tobacco or alcohol, without injury, not because they are grown up, but because their bodies have learned how to do so. Even a grown-up person taking tobacco for the first time is apt to suffer severely.

But the third reason is the most important. It is true of all kinds of living beings that they are more easily injured when they are developing. We can understand in a way how this must be, for developing is a very much more delicate and difficult process, surely, than merely continuing in the same state, which is all that the grown-up body has to do; and so we may expect that the developing body must be more delicate, seeing that it has only one way of going right, and that there are so many ways of going wrong. Only those who have studied development can understand how grave is the effect of poisons, like alcohol and tobacco, upon the developing body of a child.

HOW IS IT THAT WE SEE DISTANCE IN A PICTURE?

A PICTURE or a photograph gives us the effect of depth and distance, and what is called perspective, in exactly the same way as our eyes do in ordinary seeing. When we see anything, a photograph—that is, a light picture—is printed on the retina of the eye. It is printed on the flat, just as if it were on a photographic plate, yet we interpret this flat picture to mean something that has depth and distance.

If it is a picture we are looking at, *its* photograph on the retina is no flatter than it would be if we were looking at the real thing. Thus, in every case, the brain has to make sense, so to speak, of a flat photograph printed on the retina.

In some measure it does so by help of the fact that we have two eyes, seeing at slightly different angles. Thus one eye sees farther round one side of anything than the other does, and the other eye sees farther round the other side, and so we are helped to get the idea of depth.

When we look at an ordinary picture, however, we do not have this advantage, and yet we get the effect of distance just as we do when we look at a landscape with one eye only. So, plainly, having two eyes is not the whole explanation, or even most of it.

WHY CANNOT WE WALK STRAIGHT WHEN WE SHUT OUR EYES?

IT is really not very surprising that we cannot walk straight when we shut our eyes; it would be more surprising if we could. There is only one way in which we could possibly walk straight with our eyes shut, and that would be if the strides taken by our two legs were always equal. In that case we could walk straight with our eyes shut.

But, though we may not think it, our strides are not the same length, and this is probably true of every one, without exception. Our legs are, as a rule, very nearly the same length, but if we measure them very carefully, we shall find that they are never quite exactly the same length. So, in point of fact, every one takes rather a longer stride with one leg than with the other, and so, if we are left to ourselves, without any guidance at all, we walk in more or less large circles.

But when we find we cannot walk straight, even for a few paces, with our eyes shut, the reason is not in our stride at all, but in the difficulty of balancing. Our eyes are of the greatest importance in helping us to balance our bodies, and without them the weight of our bodies is apt to go too far on one side or the other, and then we have to take a step accordingly to save ourselves from falling, and so we thus lose the straightness of our course.

WHAT IS THE USE OF OUR HAIR?

WE inherit our hair from quite hairy, or even furry, creatures. Hair is a special outgrowth of the skin, and is a distinguishing mark of all the creatures called mammals, of which we are the latest and greatest. Fish have scales, birds have feathers, and mammals have hair. Fur is a special kind of hair. We are very much less hairy than our animal ancestors. Man has given up, almost altogether, the use of things like hair and claws for fighting or defence, and has come to live by his mind. Still, we have a little hair left, and it is quite useful; besides which, it is often beautiful. We find it almost entirely confined in ourselves to our heads, and its chief use is to protect them from the sun. It is a great pity that we do not trust it more for this purpose. Instead of that, we wear hats, so that after a time we can scarcely do without them, but are apt to get colds or sunstroke if we leave them off.

GOOD ANECDOTES TO REMEMBER

MILD JUSTICE

Professor Sophocles of Harvard College was a curiously brusque and kind-hearted man. He kept chickens, of which he was very fond. One day young Thornton's dog leaped into the henyard and caused a commotion there. Professor Sophocles was prompt in defense.

He drew a pistol and fired, and the dog, perceiving his mistake, retreated as he had come.

The following day young Thornton's father, walking down the street, was suddenly embarrassed by seeing Professor Sophocles on the same sidewalk. Remembering, however, the old man's usually averted gaze, he hoped to pass unnoticed. But as the two came abreast, gruff words and a piercing eye signaled stoppage.

"Mr. Thornton, you have a son."

"Yes, Mr. Sophocles, a boy generally well-meaning but sometimes thoughtless."

"Your son has a dog."

"A nervous dog, rather difficult to regulate."

"The dog worried my chickens."

"So I heard, and was sorry enough to hear it."

"I fired a pistol at him."

"Very properly. A pity you did n't hit him."

"The pistol was not loaded."

And before Mr. Thornton could recover his wits for a suitable reply Sophocles had drawn from his pocket one of his long sweetmeats, had cut off a lump with his jack-knife, handed it to Mr. Thornton, and with the words, "This is for the boy who owns the dog," was gone.

The incident well illustrates the sweetness and savagery of the man, his plainness, his rejection of smooth and unnecessary words, his rugged exterior, and the underlying kindness which ever attended it.

AGASSIZ AND THE HORSEMEN

In 1866, when Professor Shaler was Agassiz's assistant, the great teacher became much interested in the task of comparing the skeletons of thoroughbred horses with those of common stock.

"We had tried," says Professor Shaler, "and without success, to obtain bones of certain famous stallions from friends who had kept racing horses. Early one morning there was a fire in the stables at the Beacon Park, a mile from college, in which a number of horses had been killed and many badly scorched. I had just returned from the place, where I had left a mob of irate owners and jockeys in a violent state of mind, for the fire was supposed to be incendiary. I had seen the chance of getting a valuable lot of stallions for the museum, but it was evident that the time was most inopportune for suggesting such a disposition of the remains. Had I done so, the results would have been, to say the least, unpleasant.

"As I came away from the angry horsemen gathered about the ruins of their fortunes or their hopes, I met Agassiz almost running to seize the chance for specimens.

"I told him to come back with me; that we must wait till the mob had spent its rage; but he kept on.

"I told him further that he risked spoiling his good chance and, finally, that he would have his head punched; but he trotted on. I went with him, in the hope that I might protect him from the consequences of his curiosity.

"When we reached the spot, there came about a marvel. In a moment he had all those raging men at his command. He went at once to work with the horses which had been hurt, but were savable. His intense sympathy with the creatures, his knowledge of the remedies to be applied, his immediate appropriation of the whole situation, of which he was at once master, made those rude folks at once his friends.

"Nobody asked who he was, for the good reason that he was heart and soul of them.

"When the task of helping was done, then Agassiz skilfully came to the point of his business,—the skeletons,—and this so dexterously and sympathetically that the men were, it seemed, ready to turn over the living as well as the dead beasts for his service.

"I have seen a lot of human doing, much of it critically, as actor or near observer, but this was in many ways the greatest. The supreme art of it was in the use of a perfectly spontaneous and most actually sympathetic motive to gain an end."

AN UNCOMFORTABLE BUT HARMLESS CALLER

To the New England camper, unaccustomed to night life in the open, the advent of any prowler, however innocent, is most disconcerting. A rabbit, soft and inoffensive, has been known to create a panic in a tent, while a hedgehog has unwittingly caused nervous prostration. What would be the timid one's sensations could she hear the arrival of such a guest as is described by Emily Innes? Her experience took place in a Malay bungalow.

"One evening I was sitting up later than usual in the mosquito-house, reading. By degrees my attention was distracted by an unusual sound in the distance.

"It began by a quiet *aa-ow-m, aaowmmm,* like a gigantic sigh some enormous animal fetched out at every step as if in pain, or lame. The noise increased every minute. I thought it must be one of the sultan's buffaloes, left out in a swamp by mistake.

"Whatever it was, the animal seemed to be lashing itself into a furious rage, for the mutterings now culminated in a tremendous roar, which filled the whole air, and made not only the house but the very earth shake. When it had come to this, I burst through the mosquito-house and ran up to the Malay on guard.

" 'What in the world is that noise?' I cried. 'Is it a buffalo?'

" 'No, *mem.* It 's a tiger. I beg *mem's* pardon for coming into the house, but I am afraid to remain below, as usual.'

"At this moment a louder roar from the animal woke Mr. Innes, who had been taking a nap in a long chair. Even in waking he recognized the sound, and exclaimed, 'Hello, that 's a tiger!'

" 'Are you quite sure?' I asked.

" 'Quite.'

" 'Had we better shut up the house a little?'

"Mr. Innes reminded me that there was only one room in the house which could be shut up—my bedroom—the others having no doors; and that if I shut myself up in that it would be very hot. Besides, it would be of no use, for a fine, healthy tiger would make short work of pulling down the house about our ears if he chose.

" 'What can we do?'

" 'Do nothing, but sit down and read comfortably. The tiger won't disturb you; he is far more afraid of you than you are of him. He would not dare enter a house where there is so much light.'

"The idea of 'sitting down and reading comfortably' with a 'fine, healthy tiger' making such a noise just outside, and absolutely nothing between me and it—no comfortable iron-wrought bars, as at the zoo—was rather startling. But I did as advised; there was nothing else to do.

"Ours was a particularly easy house to get into, only four feet from the ground, and no rail. What is a spring of four feet to a 'fine, healthy tiger'! Fortunately, instinct makes him suspect a trap. After having once found the way, he will come night after night. I could usually awe one into silence by creaking a door or moving a lamp."

CAPTURING WILD PONIES

Situated about eighty-five miles eastward of the coast of Nova Scotia is Sable Island, the home of herds of wild ponies. Once a year the wild ponies are rounded up. They are driven into a pound, and are bound and taken to the hold of a government boat.

Certainly Sable Island does not exactly tally with one's preconceived notion of the character of a horse-ranch. Yet here the ponies thrive in average seasons; here they roam in ignorance of the labors which most of their race are fated to endure, until at last the evil day arrives of the annual drive, when the whole island is swept from end to end, and a kicking, snorting, terrified mass is driven into a large pound.

Two or three dozen of selected ponies are then lassoed, thrown down, bound, rolled over upon a hand-barrow, lifted up and slid into the surf-boat, rowed out, and finally hoisted on board for conveyance to Halifax.

The horses of Sable Island are seldom seen lying down to rest. They often sleep standing. They persistently refuse the shelter of a stable, or even the rough sheds erected for their comfort, and shun the near presence of man.

In severe weather it is the habit of the horses to gather in the gulches or hollows between the sand-hills. Here they arrange themselves in regular order, the colts in the centers, their elders outside of them, and the master stallion in the most exposed situation of all.

As all the ponies are under thirteen hands, their usefulness is restricted. Some prove extremely serviceable animals, easily kept, with fair speed and great endurance, especially under the saddle. As a rule, when once broken and well cared for, they become affectionate and docile.

"LAZY STREET"

There is a short, quaint street in Bremen, Germany, the name of which embodies a legend.

Once the thick forest grew where the street now runs, and the trees were old, large, and strong.

On the edge of this wood lived an aged couple who had seven sons, all big, strong, and lazy. Indeed, the boys were drones, and the neighbors said, when the brothers passed, "There go the idle seven." Every one laughed at these big lads who never worked. At last the brothers grew tired of being mocked. Said one, angrily:

"We cannot go out of the house without even the children coming up behind us and pulling our coats and crying, 'Lazy fellows!' Let us go to work."

At first the six other brothers laughed at this proposition, but finally, wearied of the neighbors' taunts, they concluded to earn their livelihood. They told their father of their resolution, but he smiled scornfully.

"You have been idle too long to be industrious," he said.

The boys persisted in their assurances, however, and at last the father said:

"If you are really determined to go to work, I will give you each a sum of money in gold and a new suit of clothes. But first you must give me proof that you are in earnest. You must each procure an ax and a spade, and, carrying your ax on your right shoulder and your spade in your left hand, walk in procession through the streets of Bremen."

At first the young men shook their heads, but finally they accepted the test. The people all came to their doors to see the strange procession go by. "The world must be coming to an end," they said.

The father kept his promise, and the boys took their money and their clothes and went off. They wandered far, worked, persevered, and acquired property. Years passed away. Many comforts came to the little home in the woods, but the sons never appeared.

One beautiful spring morning the citizens of Bremen were astonished to see seven well-dressed gentlemen, each carrying an ax and a spade, marching in procession through the city streets. There was much curiosity and also great excitement when it was found that the "seven idle sons" had returned.

A beautiful house was built where the little home stood, and the old people were surrounded with every luxury. No road ran to that part of the woods from the town, so the brothers built a broad way with their own hands.

"What shall we call our street?" they asked each other when it was finished.

"Much of our lives has been spent in idleness," said one. "What we have lost we can never get back. Let us warn young people who are inclined to be lazy. We will call the way *Faulenstrasse,* or Lazy Street."

A BOY'S ANSWERS ABOUT MOSES

In one of his books the Rev. Robert Collyer recalls the Sunday-school in Chicago which he established among the foreign residents of that city. His work consisted largely in teaching both old and young the English language, to enable them to qualify as American citizens. Along with this practical work went as much religious training as the good minister could find place for. One instance which he gives will show the work and how it was done.

"A memory comes to me which may cast a gleam of light on our success in the Sunday-school, and on the way the pupils learned their lessons.

"One of the classes had been working its way through the life of Moses, from his infancy to his call to be the deliverer of the tribes from their bondage.

"I had noticed how one bright boy would wrestle, head down, with the story. So I picked him out one Sunday to see how much he had learned, and here are the questions and answers:

"'What have you learned about Moses, my boy?'

"'The king's daughter, *she* found him when he was a baby, in a box in the rushes down by the river, and took him home to nuss him.'

"'Did she nurse him herself?'

"'No, she hired a woman to nuss him, and it was his own mother; but she did n't know that.'

"'And what did Moses do then?'

"'He grew to be a man.'

"'And what did he do when he was a man?'

"'He killed another man.'

"'Then what did he do?'

"'Buried him in the sand.'

"'What did he do after he had buried him in the sand?'

"'He run away and went to keeping sheep on the prairie.'

"'Did he stay there all his life?'

" 'No, he quit that because he saw a bush afire.'

" 'Did that scare him so that he ran away and left his sheep?'

" 'No, something talked to him in the bush, and told him to go back home; and it was the Lord what talked to him.'

" 'And what did the Lord say?'

" 'He told him to take his boots off.'

"And here ended our lesson on the early life of Moses, at which I smiled and said, 'You have done well, my boy—very well, indeed.' "

HOW THE DRAFT WAS CASHED

A New Jersey merchant who was going to San Francisco in the days immediately following the construction of the Northern Pacific route to the coast was desirous of taking with him one thousand dollars. As the times were lawless in the West, he was fearful of carrying such a large amount of money on his person, and went to his home bank for a draft.

It happened that the bank, which was a small one, did not have a correspondent in San Francisco, and to purchase a draft from one of the big New York banks would eat up the profits of the transaction. There was too great a risk and expense in attempting to ship the money to the San Francisco bank, and a large possibility of the merchant reaching the city at the Golden Gate ahead of the money. The banker was desirous, however, of accommodating the merchant and making the profit on the draft, which in those days was large. He finally hit upon an expedient.

"When are you going to start?" he asked the merchant.

"To-morrow," was the reply.

"Very well," said the banker. "Now, just before you are ready to start I want you to call at the bank to see me."

Then he made out a one-thousand-dollar draft on a San Francisco bank, payable to the merchant, and handed it over.

The next day, just before starting on his trip, the merchant went to the bank and was handed a sealed envelop, which he was requested to deliver to the San Francisco banker.

"If you will do me this favor," said the banker, "I shall be greatly obliged. I would not ask you except that you can deliver it at any time you call for your money, and I trust that it will occasion you little trouble."

The merchant expressed pleasure at being able to oblige the banker, and left. On arriving in San Francisco he went to the bank on which his draft was drawn and presented it.

"We cannot cash this," said the cashier. "I do not know this banker. His bank has no funds here."

"Well!" said the merchant, naturally greatly exasperated. "And that draft cost me a big price!"

Suddenly he thought of the letter that had been entrusted to him. Explaining about it, he took it from his pocket and handed it to the cashier, who opened it dubiously, to find that it contained a few words of explanation and a one-thousand-dollar bill.

"I find," the cashier said, graciously, as he handed the merchant the bill and took the draft in exchange, "I find that we can cash that draft, after all. Twenty-five dollars, please. That is our regular charge for cashing a draft of this kind."

"Well!" said the merchant again.

His only satisfaction was the thought that if he had lost the letter the Eastern banker would have been responsible for the amount of the draft.

THE BLARNEY STONE

Among the old castles of Ireland none is more famous than Blarney, in County Cork. It is in the walls of this building that the Blarney stone is set, a stone that has given to English speech a name for what is otherwise sometimes known as "taffy." The castle itself dates from the year 1446. It stands in a region which abounds in legend, tradition, and old-time belief in fairies.

Blarney Castle obtained its present fame from a famous stone, still in the walls, round which clusters much of romance and superstition. Tradition says that after Cormac MacCarthy had built this castle he chanced one day to save an old woman from drowning, who, to show her gratitude, offered Cormac a golden tongue which should have the power of fluent persuasiveness—a tongue that could influence men and women, friends and foes, as he willed. To get this power, however, Cormac must climb to the keep of the castle, let himself down in some difficult way, and kiss a certain stone in the walls situated about five feet below the gallery running round the top. It is said that he followed the old woman's directions with great minuteness, kissed the stone, and at once obtained all the persuasive eloquence which had been promised him.

Soon the story was told throughout Ireland. It went also to other countries, and made Blarney one of the best known castles in the world.

"Walking round the top of the castle walls in the warm sunshine," says a traveler, "I began to look for the noted stone, and at last found it held in place by two iron bands suspended from the very top of the stone battlements. A row of iron spikes has been placed on the top of the battlements above the stone to prevent foolhardy adventurers from attempting to kiss the stone by being let down over the walls by the heels, as was the custom at one time.

"Now the pilgrim to this shrine of eloquence must get down on his knees, or lie flat down on the stones, bend his body at the waist and thrust his head and shoulders down about three feet through a square opening in the stones opposite the cornice, and in this position turn his neck and kiss the stone from the under side. An attendant with good muscles must be at hand to hold the heels of the one who attempts to kiss the stone, else by the law of gravitation he will topple over and go through the hole to the ground, 120 feet below."

AT THE MERCY OF A RHINOCEROS

A few years ago a terrible accident befell an English sportsman. He was in pursuit of eland, and had passed a "rhino," which he resolved to go back and endeavor to secure. He tells the story as follows:

"The rhino was 120 yards away, with its back toward me. I sat down in grass eighteen inches high and waited. After ten minutes the rhino turned and walked slowly toward me, grazing.

"The man I had with me became frightened, and after creeping for some distance through the grass, jumped to his feet and ran. This aroused the beast, for it lifted its head and looked after the man, giving me the chance I wanted.

"I put a solid bullet in the center of its chest, and it went down heavily. There seemed to be not the slightest breath of life left in it, so I walked toward it.

"When I was less than twenty yards away the huge beast gave a roll and got on to its feet. My rifle was up at once, and I put a bullet into the shoulder; but before I could get in a second shot the brute was charging straight.

"I commenced to run, but the first step I took I tripped and fell, and before I could regain my feet it was on top of me.

"It hit me first with its nose, dropped with both knees on me, then, drawing back for the blow, threw me clean over its back. The horn entered the back of my left thigh, and I saw the animal well underneath me as I was flying through the air.

"It threw me a second time, but I cannot recollect that throw clearly; and then came a third time. I was lying on my right side when the great black snout was pushed against me. Then I found myself on my feet, how, I do not know, and staggered off.

"After going about forty yards, expecting every moment to be charged again, I felt that I might as well lie down and let the beast finish its work; so I lay down."

The spot where the catastrophe occurred was fifteen miles from camp. The nearest doctor was distant 136 miles. There on the desert veldt, a shattered wreck, with right arm smashed, ribs broken, and many minor injuries, lay the hunter, exposed to the fierce equatorial sun. It was hours before his men found him, and midnight ere they could carry him into camp. It was not until eight days after the accident that the doctor arrived, and the necessary operations could be performed.

The man lost his right arm, but otherwise bears no trace of his terrible experience.

"ONE OF MY BOYS?"

After the Civil War was over, General Sherman loved to talk about it and about "his boys," as he used to call the men who had served under him, and who came to see him from all parts of the country. Toward the close of his days this gave rise to a pathetically human incident.

Once, while the late Augustus Saint-Gaudens was modeling a figure of Sherman, the famous author Robert Louis Stevenson visited New York. Stevenson had a passion for the study of war. He knew more about fighting than most fighting men, and was especially interested in the Civil War, and in Sherman's brilliant campaign in Georgia.

He asked Saint-Gaudens to introduce him to the general, and the next day the sculptor told Sherman that Stevenson wanted to meet him.

"Who is he?" asked Sherman. "One of my boys?"

"No," said Saint-Gaudens, "he 's the great writer—Stevenson."

"Never heard of him," said Sherman. "What did he write?"

"Why, he wrote 'Treasure Island' and 'Kidnapped' and 'David Balfour'—"

"Don't know them," said the general.

"And he wrote 'Dr. Jekyll and Mr. Hyde.'"

"That 's a good play. I saw Dick Mansfield play it. Well, fetch him along."

Saint-Gaudens, the kindest and tenderest creature that ever lived, would never think of wound-ing Stevenson's sensitive soul by telling him what Sherman had said.

"The general wants you to come around to-morrow," said he to the author.

"Does he really want to see me?" Stevenson asked.

"Of course he does," said Saint-Gaudens. "Want to see you? Why, you should have seen his face when I told him you were coming."

They went to the studio the next day. When Sherman arrived, Saint-Gaudens came forward most impressively, and laying great stress on the author's name, said:

"General Sherman, this is Mr. Robert Louis Stevenson!"

"Ah, how do you do, Mr. Stevenson?" said the general. "Glad to meet you! One of my boys?"

LIONS IN THE BUSH

Lions were not specially included in the program of Mr. Abel Chapman when he first landed in British East Africa, and although, during his three months in camp in the wilderness, he heard lions calling almost every night, yet he did not see a live lion except on a single occasion. Mr. Chapman says:

"It is perhaps needless to remark that lions do not roar when hunting at night. It would be a very foolish beast that did so. When the lion-hunt was arranged and my position given me, I stationed myself in the long grass about half a mile from the noisy line of beaters.

"My Somali gun-bearer, Elmi Hassan, lying beside me, pointed into the wood, saying, 'See! two lions! You no see?'

"I certainly did not see. For some time I could distinguish nothing moving whatever; but at last, as the lions came exactly opposite my position, where the wood was rapidly thinning out, I saw them.

"They were not easy to detect, so low and stealthy was their advance. At a point exactly on my front the two beasts lay down in two green bushes that grew within a dozen yards of each other beneath the last straggling trees. I beckoned to my left-hand neighbor, told him what I had seen, and arranged that he should advance from the left, while I went straight in to the lions in front.

"Naturally, under such circumstances one went in with every sense on full stretch, anticipating and prepared for any contingency; but on drawing nearer and nearer to those two bushes without seeing a sign of movement within, the tension began to slacken.

"At twenty yards' distance it seemed impossible that so large a beast as a lion could be lying in so small a bush without my seeing it. They must, I thought, have slipped away unobserved, and I was walking on almost carelessly until within ten yards of the right-hand bush, when Elmi suddenly seized my arm, pointing the rifle he carried into the base of the bush, and hissed, 'See! see! the lion! Shoot—him spring!'

"Once more I must admit that I could see nothing. Strain my eyes as I would, I could distinguish nothing. Yet Elmi was so positive that I decided, perhaps rather recklessly, to fire.

There was no mistaking the response, a growl more savage than ever I had heard in my life before. I saw, through the smoke from the Paradox, the electric convulsion with which the beast pulled itself together for a spring. That movement disclosed the position of the head and shoulder, and before there was any time for mischief, I sent the second bullet, and the beast dropped dead.

"While rushing forward to examine the beast, and in the excitement forgetting the second lion, I was promptly reminded by shouts and two rapidly fired shots in that direction.

"Turning, I was just in time to see this second beast bound out from the thick covert. I remember seeing her white teeth as she commenced a growl. She was only twenty yards away, but that movement was her last. A Paradox bullet on the shoulder dropped her."

A SINFUL INSTRUMENT

A recent book makes mention of an old-time Southern preacher whose determination not to have his church turned into a concert-hall was expressed somewhat amusingly from his pulpit. Against his sanction, a violin had been brought into the choir. On the first Sunday after its introduction, when it came time to announce the hymn, the congregation was amazed to hear:

"We will now sing and fiddle hymn number sixty-five."

A smile passed over the congregation, which had not entirely faded when the reverend gentleman announced the second hymn:

"Please fiddle and sing hymn number thirty-nine."

Almost a titter was audible, discreetly covered at once by lusty singing. When the time came to announce the third and closing hymn, the old minister said, clearly and distinctly:

"Let us sing and fiddle, and fiddle and sing hymn number one hundred and two."

DOING THINGS INDOORS AND OUT

PART II

THE SUNFLOWER CHORUS

BY EDWIN STANLEY THOMPSON

THERE was a church festival in Hensonvale, and this is the way in which Miss Belle Abbott introduced a new feature into the well-worn list of such entertainments.

A placard was prominently displayed at the festival reading:

SOMETHING NEW. DON'T FAIL TO SEE IT.

All were kept in mystery until the appointed time, when the manager, stepping before the curtain, spoke of the statue of Memnon in Egypt, which was accustomed to greet the rising sun with song.

"More obliging than Memnon," he said, "certain stately American sunflowers have been found ready and willing to sing whenever called upon. Ladies and gentlemen," he added, "I have been fortunate enough to secure for our festival a cluster of these remarkable additions to our native flora, and have the honor of presenting to you our Sunflower Chorus."

The slowly drawn curtain revealed upon a dark background thirteen large, yellow sunflowers, with leaves and stalks complete, and in the center of each a human face. Music came from the piano near the stage, and to its accompaniment the cluster of human sunflowers sang numerous selections from familiar operas, popular songs and melodies, and college glees.

The Sunflower Chorus was voted a great success, and those not in the secret begged Miss Abbott to tell them how it was done. And this was her explanation:

One foot behind the stage curtain, hang another curtain of dark-brown cambric, ten feet square; attach this by rings to a wire stretched nine feet from the floor; tie cords to the first and last rings and, drawing the curtain tightly, fasten these rings to the wall on each side. The top being now secured, let the curtain hang naturally; wrap the surplus cloth about a strip of wood twelve feet long, two inches wide, and one inch thick; fasten this to the floor by two large screws, and the flower screen will be tightly stretched.

Group the singers in a picturesque cluster behind the screen, with their faces pressed against the cloth, and at distances from the floor varying from one to eight feet; mark the position of each face, and cut, in the screen, a hole into which the face will closely fit. Going now to the front of the screen, arrange the flowers and leaves, which should be fully prepared beforehand. The rays of the sunflowers may be cut from yellow paper, and the leaves and stalks from green paper. Paste the rays around the openings, then arrange the stalks and leaves in proper position.

When the paste is dry, remove the strip of wood from the bottom of the screen, unfasten one of the cords at the top and slide it back until needed for use, when it may be easily put into position.

If the stage curtain slides, it should be allowed, when drawn aside, to stop at the ends of the flower-screen; if it rolls up, it will be necessary to fill up the space between the screen and the sides of the stage with drapery.

In summer the natural stalks and leaves of the sunflower may be used instead of those made from paper.

A SOAP-BUBBLE AND ITS SECRETS

BY JACOB F. BUCHER

MANY of our readers have spent hours over those delicately colored wonders, the soap-bubbles. Most of us have wondered how to explain their beauty and form; or, while idly blowing these balloons, we have connected them with some fairy fancy, and have been led to think of charms and enchantments. Many of us believe still, as we believed when children, that no gem surpasses a soap-bubble in beauty; and one cannot help feeling really sorry when each exquisite plaything bursts.

Nor do children alone mourn over their short existence. Sir Isaac Newton, who sought out the secret that a falling apple hinted, said of the soap-bubble that a man or child who could blow one that would last would confer a great benefit upon mankind. You will wonder at this saying, but the truth of it will soon be apparent.

No one yet has been able to make a soap-bubble that will not burst, but by care we can make one that lasts for some time. Its length of life will depend largely upon the mixture used in blowing it, and the care we take in protecting it from drafts. Perhaps some of you do not know how to make a good soap-bubble mixture, so I will give you directions for preparing one.

Put into a pint-bottle two ounces of best white Castile soap, cut into thin shavings, and fill the bottle with cold water which has been first boiled and then left to cool. Shake well together, and allow the bottle to stand until the upper part of the solution is clear. Pour off this clear solution, add half as much glycerin, and you will have a fine soap-bubble mixture.

Some of you may wonder why bubbles cannot be blown from water alone. It is because the particles do not possess sufficient attraction for one another to form a film. Mysteriously, the soap increases this attraction, even if the quantity be as small as one-hundredth part of the solution. We add the glycerin to make the film more gorgeous by bringing about a greater play of colors. Bear in mind that a carefully prepared mixture will save you much disappointment.

The solution now being at hand, we use the ordinary clay tobacco-pipe in blowing. Always use a new one, for one in which tobacco has been smoked is poisoned. With a little practice, and a moderate amount of patience, bubbles measuring eight or ten inches in diameter may be produced, and even larger ones if the lungs be refilled. The pipe, of course, should be held steadily, and the breath forced into the bubble evenly. In order to watch a bubble carefully, we may wish to support it in some way. A common tumbler will make a good stand if its edge is first dipped into melted paraffin, or well soaped, which prevents it from cutting into the film.

Now as to the soap-bubble being a sphere. We find that all bubbles and drops are round. All liquids, when free to act, tend to take on the spherical form. So it is with milk when it falls upon a buttered plate, a rain-drop when it descends, or the dew that glistens so beautifully in the morning sun. In each case the drop is composed of tiny particles that are equally attracted by a central particle, and as they cling regularly around it give the drop a round shape. Your school-books have told you that this attraction that causes all things to try to come together is gravitation. Here is a pretty stanza written by Samuel Rogers, teaching this truth:

> That very law which molds a tear,
>   And bids it trickle from its source,
> That law preserves the earth a sphere
>   And guides the planets in their course.

In the case of the soap-bubble the case is reversed. The particles of air within press with equal force outward upon the film in all directions, producing the curved surface and making a hollow sphere. If the room is free from drafts, the bubble will be a perfect one, and will teach us the principles that underlie the making of a sphere. This perfect form, however, is seen only when the bubble floats. When resting upon the goblet, it appears very much like an orange—that is, a sphere slightly flattened, the true shape of the earth. Putting it into the simplest language, the form of a bubble is due to the holding together of the soap solution, to the outward pushing of the air within and the resistance of the film.

If the air in the room is moderately cool, the bubble will float like a tiny balloon. The mouth and lungs at all times having a temperature of nearly one hundred degrees, the air blown into the toy bubbles is warmer, and consequently lighter, than the air which surrounds them; therefore they float, and it is their lightness and grace that, with their beauty, give them such a charm. As soon as the air within the bubble cools, it slowly sinks till it reaches the floor, and the jar of its contact usually breaks the film.

The extreme thinness of the bubble is indeed wonderful. It is estimated that the film in some places is only one *three-millionths* of an inch in thickness. Probably few of us can conceive of such thinness. Let me express it in another way. The Old and the New Testament contain some three millions of letters. Now one three-millionth is such a part of an inch as the first letter of the Bible is a part of the sum of all of its letters.

The bubble, however, is not of equal thickness at all points, and it is for this reason that it has the various colors. For instance, wherever the film is orange-red it measures about three one-millionths of an inch; where it is blue, eighty one-millionths of an inch; and at a point where lemon-yellow is prominent, about twenty one-millionths of an inch. Perhaps you wonder why the colors change from one part of the soap-bubble to another. This is because the film of the soap-bubble evaporates and grows thinner, but unequally so at different portions. A greenish blue with a pale rose-red spot near it indicates an extreme thinness, and at such a point the film is ready to give way at the least jar.

You will be glad to know the source of the beautiful colors. Every one is delighted with them, even if not interested by the explanation of their origin. We may say that they come from the light. Light gives color to all objects, but not exactly as it does to the soap-bubble. White light from the sun can be broken into the seven colors which we have seen in the rainbow. In that instance the raindrops separate it into its parts. A glass prism will do the same, as you may prove by looking through a glass pendant from a hanging lamp.

When the light reaches the surface of the soap-bubble a part is reflected from it, and we see images on its surface as if it were a curved mirror. Another portion of the light, however, enters the film and is separated so that a part of the seven colors are thrown into the bubble, and we can see them at various portions of the opposite surface. Another part of the light, after being broken by the film, is reflected by its inner surface back to our eyes, so that we see colors at the point where the light enters.

Such a simple line of investigation as the study of a mere soap-bubble has often awakened the natural liking for some particular group of studies, and thereby started a boy or girl properly upon a life work. It is our supposed familiarity with common things that frequently robs them of the study and interest that might otherwise be profitably bestowed upon them.

THE GIBSON BOY

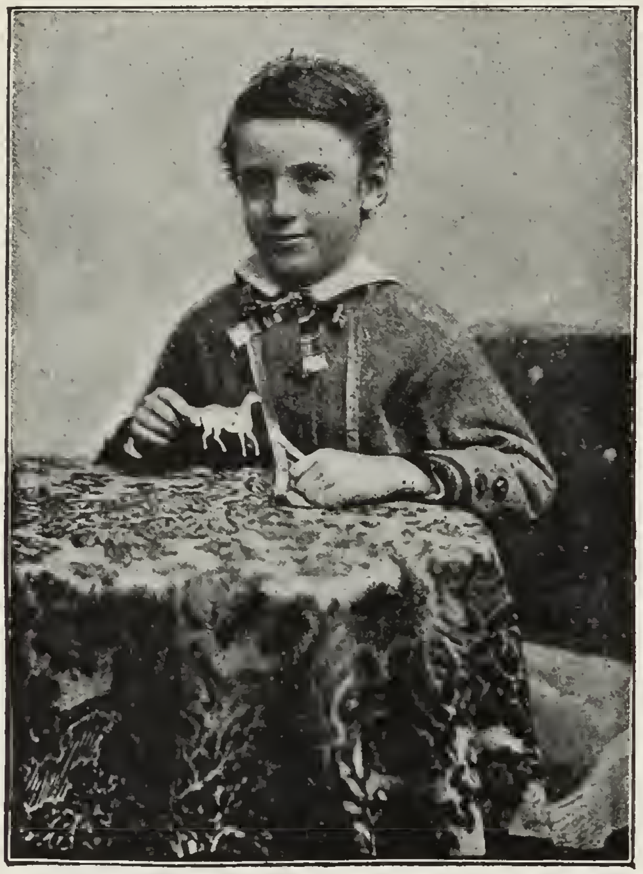
(*Paper-cuttings by Charles Dana Gibson when a boy*)

BY CHRISTINE TERHUNE HERRICK

NOT *so* very many years ago a certain small Boston boy had a slight attack of illness. It was nothing serious in itself, but it led to something remarkable; for, one day, when the patient was rather fretful and listless, his father, to amuse him, began with a pair of scissors to cut out figures from paper—a horse, a dog, a cow. The little lad was instantly interested, and his delight was doubled when he found that after a few trials he, too, could make pictures with the scissors.

From that day he and they were almost inseparable. His mother feared he might injure himself with sharp scissors, and so he was provided with a good-sized pair of round-pointed shears. These he wore hung by a string around his neck, and everywhere he went, they went too. The little fingers were constantly busy turning out silhouettes of everything that attracted the child's fancy, until he became as skilful with his odd tool as many an older artist is with his brush. Strangely enough, he showed no desire to draw, and of all those who marveled at his knack of picture-making and wondered what would come of it, probably no one imagined that in later life he would win a brilliant reputation with his pencil. For the little boy of those days is now the

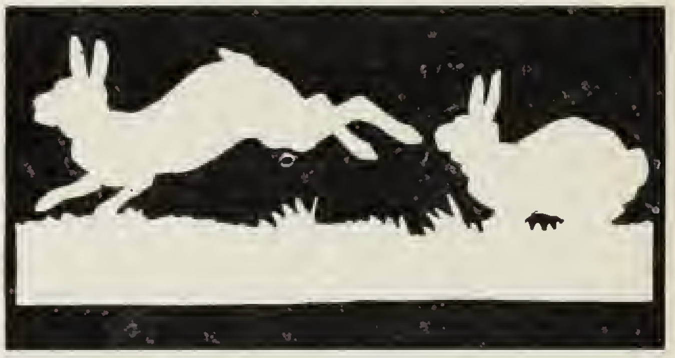
Charles Dana Gibson whose work has gained such eminence in the last few years that it is almost unusual to take up a copy of a high-class magazine that does not contain at least one article illustrated by him. Every one knows "Gibson's girls"—those majestic and charming creatures who put into visible form the ideal of the best type of American young womanhood; but it seems a long way from them back to the quaint products of the artist's childish skill.



CHARLES DANA GIBSON AT THE AGE OF EIGHT.

The earliest attempts of the small boy's fingers were rude, naturally enough. He began by cutting out pictures of monkeys, and quickly went on to other animals. While there could never be any doubt what the figures were meant to be, it must be acknowledged that the earliest apes and squirrels were wanting in spring, and that his dogs and horses lacked spirit. But these qualities came with the incessant practice the child bestowed upon the work which was also his favorite play.

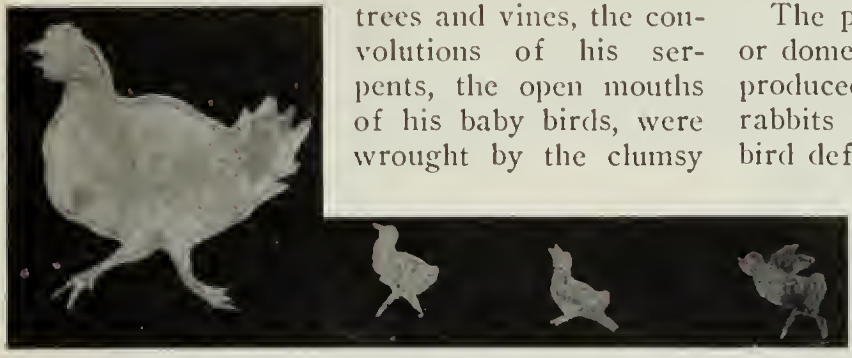
He found his models everywhere: the circus and the menagerie abounded in suggestions for pictures, the Natural History Museum was a treasure-house of designs. The image of the animal seemed to be photographed upon the child's brain, and as soon as he was at home the scissors were at work reproducing the figure.



To look at the boy as he worked, no one would have thought him especially intent upon his occupation. He would sit quietly, his eyelids drooped, apparently indifferent to the fate of the picture he was shaping. He did not shift the shears in cutting, as an older person would do, but held them stationary and moved the paper. When he began to use the scissors his hand was too small to hold them in the ordinary fashion, so while his thumb was thrust through one loop of the handle, his fingers closed around the outside of the other loop—a trick Mr. Gibson has never unlearned, for to this day he wields a pair of scissors in the same manner as in his almost baby days.

To the little artist the material upon which he worked seemed to be of no consequence. Any paper, white or tinted, thick or thin, blank or written over, would answer, so long as it was uncrumpled. There was no paste-brush used to

join different parts of his pictures; a single piece of paper would serve for a figure, and sometimes for a series of figures, or for a whole scene. The delicate foliage of his trees and vines, the convolutions of his serpents, the open mouths of his baby birds, were wrought by the clumsy shears with as much apparent ease as the bolder outlines of his figures of people and large animals. In and out of the jaws of the big scissors would move the slip of paper, until the lace-like picture fluttered forth complete.



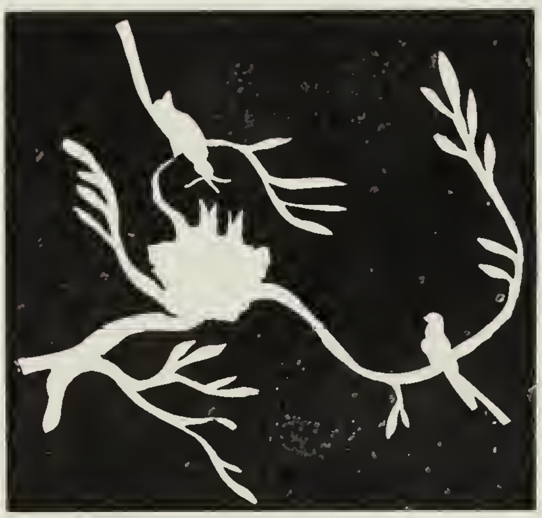
As the child grew older he did not restrict himself to copying in his silhouettes only the living or pictured models that came in his path. His future skill as an illustrator was foreshadowed in the way he chose his subjects. He would come home from school full of some story he had heard there.

"They read such a nice story in the class today," he would say. "See, I will make you a picture of it."

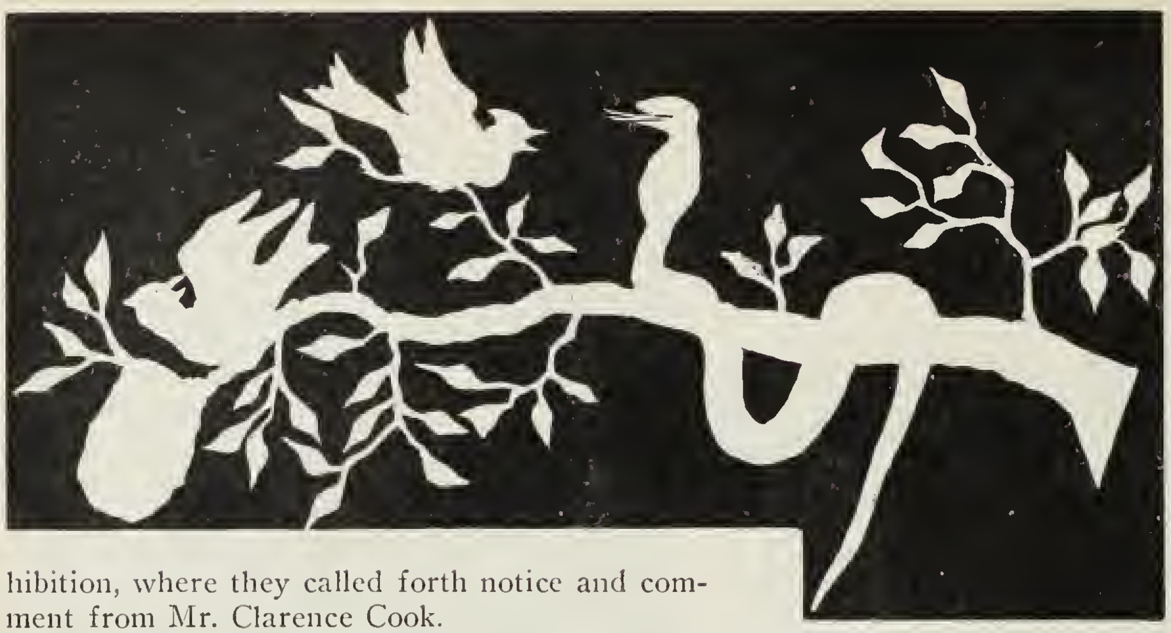
And forthwith the fingers would be at work cutting out the image of the dog who took care of his master's horse, of the countryman who whipped some balking mule, or of the quarrelsome rooster in his various belligerent attitudes. One of his most laughable works shows a hen and her chickens fleeing before the pursuing foe. Each little chick is evidently in a different state of mind from any of the others. The first tiptoes along sedately serene, because it is close to its mother; the second makes longer strides to overtake the old hen; while the third, conscious of the fierce enemy close behind, brings its wings to aid its legs in flight.

The pictures did not always deal with homely or domestic subjects. Sometimes there would be produced a mounted Indian on the war-path, or rabbits leaping through the grass, or a father bird defending the approach to his home against a thievish snake with darting tongue, while the mother bird hangs protectingly over the nest that swings from the end of the bough.

The little Dana had other inspiration than that furnished even by the stories he heard or the pictures he saw. His quick imagination was at work devising scenes to illustrate, and droll and tricksy fancies leave their mark on his work. Here a small dog, with spectacles perched on his nose, rides a pony. Here a rabbit and a squirrel meet, and shake hands. To the rabbit is given a haughty air, for its head is thrown back as if it scorned the bushy-tailed squirrel. And how appealing is the squirrel, who must be about to ask a favor. In spite of big ears and bushy tail, the little creatures are so well balanced that there seems no danger of their toppling over. Again, it is a small pig that struts along with his umbrella spread over his head, while all the birds look at him in amazement; or else it is an attempt at caricature in the picture of a boy with an abnormally large head and absurdly long fingers and toes.



No wonder that the family and friends marveled at the cuttings, and collected and preserved specimens of the child's work. They even had some of them displayed at an art ex-



hibition, where they called forth notice and comment from Mr. Clarence Cook.

"But perhaps the most remarkable thing in the whole exhibition," he wrote, "are the frames that contain the silhouettes in white paper, cut by Master Dana Gibson, a boy now ten or twelve years old, but who cut many of these figures—and many of the best of them—when he was but eight years old. In almost every case they are cut from the idea in his own mind, not copied from other pictures, and they are done without any aid whatever from teaching; the work is the product of instinct without training. The subjects are all of life in action; whatever is done, is done with a perfection that we never saw surpassed."

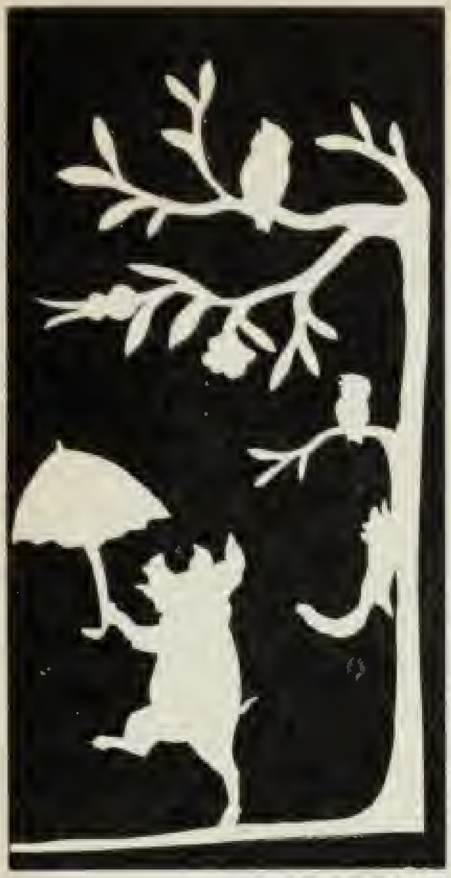
So far from seeming unduly puffed up by the praise his skill received, the child showed only surprise. To him there appeared no difficulty in such work.

"Any one could do it," he would say simply, when some person would comment upon his proficiency. "Any one can do it who will try. It 's the easiest thing in the world."

For none of his designs did he ever draw an outline. In fact, at the time he was doing his best work of this kind he had never taken a drawing-lesson, although he belonged to a family of artistic tastes, and his grandfather, his father, and his mother had all had more or less facility with brush or pencil. But the lad's designing was done altogether with his scissors. With only these he managed to convey shades of meaning and of expression, and to give spirit and life to his pictures. Even although he repeated his subjects again and again, there was great variety in his work.

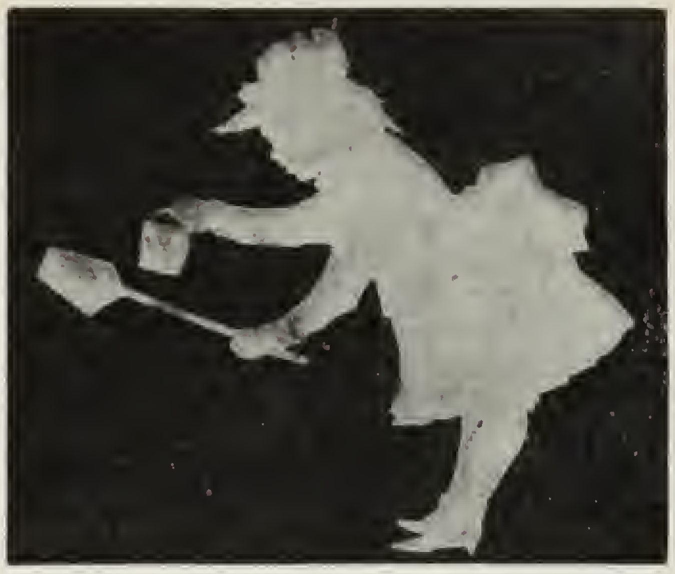
And he had infinite patience. Over and over he would cut out a picture until he had it, to his mind, exactly right. His failures would be crumpled in his hand and tossed aside without a word. One day some one who had watched him as he rejected cutting after cutting, asked him what was the trouble.

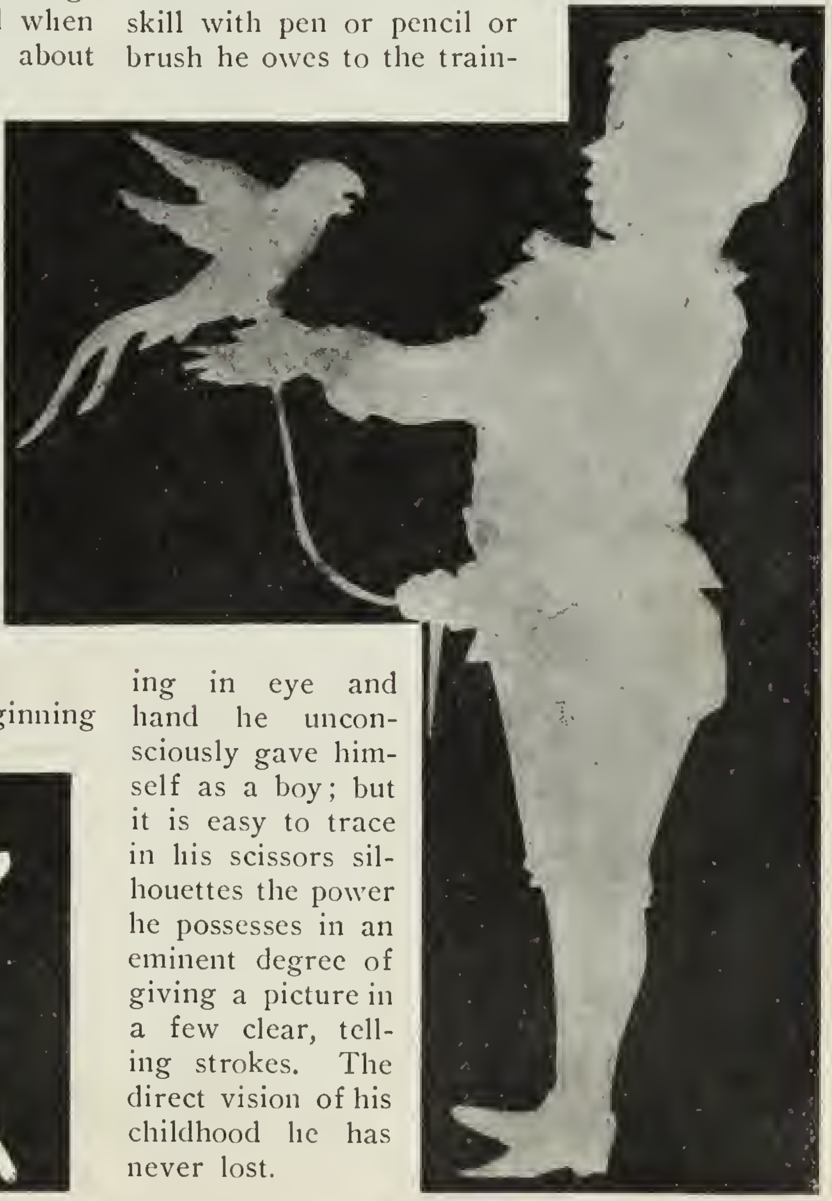
"It 's that dromedary's lip," sighed the child, pausing in his work and lifting a puzzled brow. "I have tried and tried, but I 'm afraid I can't get it right without going to see the dromedary again. If the long lips are not right the whole head looks queer."



Until Dana was ten years old he was a rather quiet, stay-at-home little fellow. He was full of fun of a dry kind, and occasionally there would come a flash of sarcasm that showed his wits were not confined to his finger-tips. As he grew older and became interested in outdoor sports and made boyish friendships, his paper-cuttings began to be neglected, and when he was about fourteen years of age he laid down his shears. In their place he took up the pencil.

Among the last of his silhouettes that have been preserved are the picture of a child digging in the sand, and that of the boy with the cockatoo perched upon his wrist. The eagerness of the little girl as she bends forward so that her short skirt tilts up at the back, her lips parted, her shovel and pail firmly grasped, are photographic in their clearness; while in the pose of the boy the mingled pride and fear with which he holds the bird are as accurately given as the minutest details of his dress. No shading or coloring could make the picture more vivid.





This slight sketch tells only of the beginning of Mr. Gibson's artistic career. The paper silhouettes were followed by pencil sketches, and these in turn by the charming pen-and-ink sketches, so widely admired. No one can say how much of his wonderful skill with pen or pencil or brush he owes to the training in eye and hand he unconsciously gave himself as a boy; but it is easy to trace in his scissors silhouettes the power he possesses in an eminent degree of giving a picture in a few clear, telling strokes. The direct vision of his childhood he has never lost.

COUNTING

BY C. K. WEAD

Can you count? Of course you can rattle off a string of numbers, one, two, three, four, etc.; but can you count a lot of things and count them twice alike? If you can, it is more than most people can do. For, easy as it is to say the numbers, it is so hard to keep the mind steadily on the task that one is very likely to "lose the count." So ingenious people have invented all sorts of contrivances to help in this very necessary and very tedious work of counting; and doubtless bright folks are constantly re-inventing some of these helps. They are the more necessary if the count is to continue for a long time.

Some of the simplest helps are: to take out a token or tally for each thing to be counted, as a lump of coal or a potato for each basketful carried into the house; to tie a knot in a string for each article to be counted, or to cut a notch, as the savage does on his weapon for each animal or enemy he has killed; to drive a nail, as the Romans kept count of years by driving one annually in the temple of Minerva; to make a mark for each item, grouping the marks by fives, or spacing them as the Phenicians did. In all these cases the memory is relieved from carrying the count through perhaps hours or days; and for the counting of the original things there is substituted a quick count of the same number of tallies or marks.

Another simple help is to collect the objects into uniform groups, and count the number of groups; then, of course, we have to multiply the number of groups by the number of objects in each group. Thus the grocer, instead of counting out twelve eggs, will pick up twice from the basket three eggs in each hand; a boy counting his money will divide it into equal piles, as 25 cents in each; the bank-teller keeps his bills in packages and his coin in bags of $100, $500, $1000, etc. A lot of coins just alike are sometimes counted by taking a board with, say, 100 holes or pockets, each just large enough for one coin, and brushing a handful of coins over the board so as to fill all the holes, and repeating the operation till all the coins are counted. Postage-stamps are sold in sheets of 100, and envelops in packs of 25, counted by machinery. Very rapid sounds may be counted in this way. Thus by grouping in his mind into fours the rapid sounds called "beats," and calling out once for each group, a musical friend counted beats as fast as sixteen in a second. The squares on an engineer's "section-paper," or the designer's "point-paper," or the worsted-worker's canvas are grouped by colored lines; and on a foot-rule the uniformity of fine lines is broken by making them of different lengths.

When the objects are in motion it is very easy to make a mistake. Suppose a line of men marches by, one man passing you every five seconds, and you begin to count them, one, two, three, etc.; when half a minute is up you will be saying seven, at the end of a minute, thirteen, of two minutes, twenty-five; so it will not do to divide the whole number of men passing by the time, unless you begin naught, one, two; in other words, the number to be divided is the difference between the numbers called at the end and beginning of the time—in this case, six, twelve, twenty-four.

This kind of mistake is so common that it is not usual to find in physical laboratory work a boy who can count correctly the number of swings of a pendulum in, say, a minute; he will generally get the number one too great.

When a lot of things close together are to be counted, some means must be taken to insure counting them all and to avoid counting any twice. So the man who buys ties for a railroad puts a mark of red chalk or paint on the end of each tie when he counts it, as everybody who rides on the cars has seen. In the British Parliament, when a vote is taken, the members present go out into the lobby and then pass back into the hall, those voting "Ay" through one gate, and those voting "No" through another gate, and as they pass through they are counted by tellers. Similarly in our Congress some votes are taken by having the members pass by tellers.

Besides these simple helps to counting, there are many ingenious mechanical devices in use. Perhaps the most familiar of these is the fare-register seen in street-cars, on which a pointer moves one division over a dial every time a fare is rung up. Very similar in principle are the counters used on printing-presses to tell how many papers are printed, though the papers come off faster than a person can count them; and the little counters look something like a watch, that one may use, say, to count the number of lines of men that pass in a procession. The voting-machines used in some cities at the last election are in principle counting-machines, and so are the devices for packaging envelops and so forth.

The cyclometer on your bicycle differs in principle from these instruments only in having the dial divided so as to give, not the number of turns the wheel makes (which you do not care to know), but the number of turns multiplied by the circumference of the wheel and the product reduced to miles; so a cyclometer made correctly for a 26-inch wheel, if used on a 24-inch wheel, would read twenty-six miles when you had gone only twenty-four miles. Similarly a pedometer really counts the number of one's steps, but, if properly adjusted for length of step, the dial will give in miles the distance one walks. This story is told of a man walking a long distance on a wager: at one time he got considerably ahead of his watchers, who were following him in a carriage; when they found him he was in a hotel, dancing, and, according to his pedometer, he had traveled many more miles than they had done. If you wish to have any instrument tell the truth you must treat it fairly.

A clock or watch is in fact a counter of the swings of the pendulum or balance-wheel. During one day these swings number not less than 86,400 (except in tower clocks), and in what is known as a "railroad watch" they number five times as many. But nobody cares to know how many swings happen to have been made since noon or midnight: we want them grouped into seconds, minutes, and hours; so the wheelwork and dials are made to perform this grouping and reduction. The "fork-clock" of the Paris instrument-maker Koenig has, instead of a pendulum, a tuning-fork which makes 512 single vibrations in a second!

The most striking application of machinery to the purposes of counting is in the electrical machines used in the census office. In the last census, thousands of enumerators all over the country were busy writing down on large sheets of paper the names of all the people in the United States, their age, color, sex, place of birth, occupation, etc. If the only thing wanted were the number of people in the country, it would be enough to count the names on all these sheets and add them together. But the census experts wished to find out perhaps a thousand other things: as how many native-born white men there are aged twenty, twenty-five, etc.; how many foreign-born white men there are of these ages; similarly for women and colored people; then there are the questions of place of birth, occupation, etc., to be answered, as how many Texans were born in Ohio. Now imagine that all the people in the United States could march in a few months before a thousand officials, each one of whom counted only the people of one particular class or description, as white males, white females, white carpenters, Italian girls ten years old, negro farmers, etc.; then there would be obtained the various facts for which the census is taken.

The practical operation of the census gives the same results as this imaginary operation. It comes about in this way: For each one of the 90,000,000 people of the country a card a little larger than a postal-card is prepared, containing all the information on the enumerator's sheets except the name, a number being used instead. This information is expressed by punching holes in certain places: thus a hole in one place means "white," another "male," another "35 years," another "blacksmith," and so on.

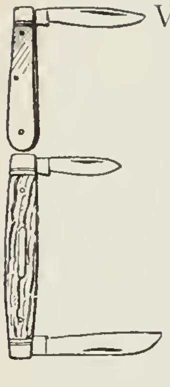
These millions of punched cards represent one by one the individuals of the nation, and they may be passed before the eyes of the supposed thousand officials, each of whom is to note his special facts. Going a step farther in simplifying the work, instead of the official counters mechanical counters may be substituted; and instead of trying to use a thousand at once, a smaller number may be used, and the cards be gone over several times. The machine will pick out the facts it is told to pick out, and no others.

The apparent intelligence of the machine may be explained thus: when the card is put into the machine, some two hundred and fifty spring needles are brought down on it; wherever there is a hole one needle goes through and down into a drop of mercury, and so closes an electric circuit and causes the pointer on a counter to move forward one number. Thus, as many of the items on the card can be counted at once as the operator finds desirable; then another card is put in the machine and the same items are counted if they are on it. Besides this, the machine can be arranged to count several items in combination, as native-born white male doctors; and it is intelligent enough to ring a bell and refuse to count if the card is not put in properly, or is punched to read widower aged ten years, woman aged twelve, female blacksmith, or any other of a score of improbabilities or impossibilities.

What a long road it has been from the savage counting that runs only to four, up to these machines that have the patience of material things and an intelligence that seems almost human, and a capacity and rapidity of work that far exceeds anything that man can do without mechanical helps!

THE ART OF WHITTLING

BY B. L. ROBINSON



EVERY American boy finds many uses for his jack-knife. It is equally indispensable whether he is cutting darts out of shingles, making willow whistles, or trimming kite-sticks; to say nothing of carving initials on fences and desks, or playing mumble-peg. But whittling as an amusement is probably not so common now as it was a half a century ago, when toys of all kinds were much less numerous, and the pocket-knife—often the boy's only store-bought possession—was accordingly much more important as a source of entertainment.

While every one should rejoice in the many sports and varied devices which at present contribute so much to a boy's mental and physical development, and give him the steady and skilful hands so useful in after life, still it is to be regretted, if in our days of baseball and tennis, of amateur printing-presses and kodaks, the ingenious use of the jack-knife that has made the Yankee boy proverbially a clever whittler should become a lost art. Anxious that this may not be the case, and hoping to draw the attention of my readers to a pleasant pastime, I shall describe some of the curious objects which, with due care and a little practice, can be whittled out with a pocket-knife.

Several things are very necessary if one wishes to get good results in whittling. First of all, he must have a knife with a rather small and very sharp blade. It is not at all requisite that it shall be a high-priced knife: indeed, expensive knives are usually of very hard steel, difficult to sharpen, and so highly tempered that they are much more brittle and not so good for the purpose as one of moderate price. The latter, it is true, does not hold its edge so well, but, on the other hand, is much easier to keep in good condition. Every boy should learn to sharpen his knife, and should do it frequently. It is not necessary to grind the edge away upon a grindstone unless the blade is very dull indeed; but it should be carefully rubbed upon a whetstone or oilstone. Even a smooth, flat pebble of some slaty rock may be successfully used as a whetstone.

In choosing a piece of wood for whittling, several points are to be noted. The hard woods are much prettier than the soft kinds, and if one has a good stock of patience and is content to make slow progress, they are to be preferred. Perhaps black-walnut is the best of the hard woods. Its grain is usually straight, and, when perfectly dry, it is not nearly so hard to cut as oak or maple. It is only the heart-wood of the black-walnut has the rich dark-brown color, and is much used for furniture and cabinet-work. In the growing tree there is an outer layer of sap-wood, as it is called, that is quite as white as maple. This white layer in a good-sized tree may be an inch or even more in thickness, and it is sharply contrasted with the dark heart-wood.

In a lumber-yard where black-walnut is kept, it is often possible to find boards or blocks which have both kinds of wood in them, and, if they are used in carving, this natural contrast in the color of the wood may be used to give very pretty effects; indeed, a sort of wood-cameo can be made from them, the white sap-wood being used for the figures, and the dark heart-wood below forming the background. This sort of work, however, is more in the line of carving than whittling, and is rather difficult for the beginner, especially as the sap-wood is harder than the heart-wood.

Of other hard woods the butternut and cherry may be mentioned as especially attractive in color and grain. Some kinds of wood, too, which are seldom used for lumber or cabinet-work but are still abundant enough in our forests, especially in the Middle States, will repay a boy for experimenting upon them. Thus the coffee-nut tree has a very pretty brown wood with a fine grain. The osage-orange, so often cultivated for hedges, has a beautiful yellow wood, taking a high polish, but it is so hard that it is very difficult to use. The oaks and maples are also too tough and hard to work conveniently. Indeed, if a boy wishes to make rapid progress, he had better be content, especially in his first few efforts, with the soft woods. These are pine, fir, and spruce; or, as the Germans call them, from the shape of their leaves, the needle-woods. For our purposes the best wood of all is a straight-grained piece of white pine, well dried, but free from the

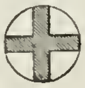


FIG. 1.

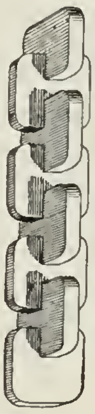


FIG. 2.

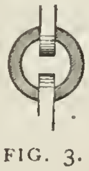


FIG. 3.

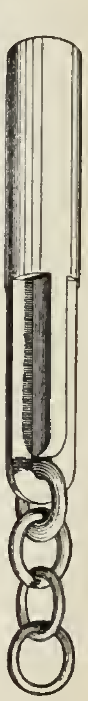


FIG. 4.

cracks so likely to come from a rapid seasoning.

One of the commonest feats with the jackknife is to cut a chain out of a single piece of wood. This is not difficult, and forms, therefore, an excellent design with which to begin. In making the chain a piece of wood is first trimmed into the form of a cylinder or roller, perhaps an inch in diameter and as long as the chain is to be, say six or eight inches in length; a piece of a broom-handle will do very well. In this cylinder four deep long furrows are then cut in such a way that the end of the block, instead of being round, now looks like a cross with the four arms equal, as in Fig. 1; each arm being the end of a wing or a long rib that extends lengthwise along the block.

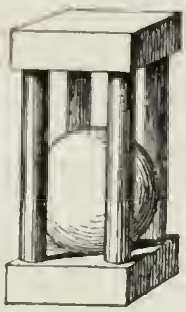


FIG. 5.

The next step is to cut notches in the wings at equal distances from each other and in such a way that in each wing the notches shall just correspond to those of the opposite wing, while in the two other wings the notches alternate with these. This is not so easy to explain in words, but will be clear from Fig. 2. The position and general form of the links in the chain are now apparent, and one may begin to hollow out the inside of each of them. To do this a hole is cut through the link as in Fig. 3. When this has been done with two successive links it will be found that they are connected only by a small bridge of wood, and this may now be cut away very easily, due care being exercised not to cut or split either link in the process. As soon as the links are loose they can be readily rounded and smoothed, and trimmed as slender as desired. In Fig. 4 the process is represented in its various stages.

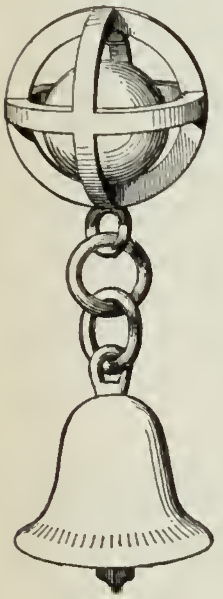


FIG. 6.

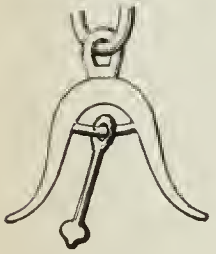


FIG. 7.

A pretty variation upon the simple chain just described is a chain with double links. This can readily be made from a single-link chain by cutting a notch lengthwise all around each link and gradually deepening it until the link has been cut into two rings. Other variations can be easily devised, such as making the alternate rings smaller or of different shape.

Another popular design, which is scarcely more difficult than the chain, is the ball in a cage. This is represented in Fig. 5, and is whittled out of a single block of wood, perhaps an inch or an inch and a half square and twice as long. The frame or cage is designed first, and the lower part of its interior is left solid to form the material for the ball. When the general form of the frame has been completed, the ball may be gradually rounded into shape and finally cut loose from the inclosing frame, care being taken not to trim it too small; for if it should roll out, the whole point of the performance would be missed.

A similar design, a little harder to make, is a ball within a spherical cage, or, as it may be called, a ball within a ball. This is represented in the upper part of Fig. 6. It will be seen that the cage consists of three connected circles meeting each other at right angles. Between these circles there are eight large triangular openings, through which one can see the ball inside. To make this design, a piece of wood is first trimmed into a sphere about an inch or an inch and a half in diameter, and the outlines of the eight triangular openings are traced upon its surface with a pencil. When this has been done, each of the triangles is dug out as neatly as possible into a shallow pit about a quarter of an inch in depth. This is the hardest part of the task; but with a sharp knife is really not difficult, as the rounded form of the ball enables one to cut from different directions. It will now be found that the circles stand out upon the surface, and it only remains to cut away a little of the wood under them in order to loosen the ball inside. The rounding of the ball and smoothing of the cage can then readily be accomplished.

At the other end of the little chain in Fig. 6 is a bit of whittling that is really difficult. It is a bell with a movable clapper. Its mechanism will be understood from Fig. 7. Of course the clapper and the little rod inside the bell upon which it hangs are both cut out of the solid block from which the bell was formed, and the great difficulty of the design is in making the little ring at the upper end of the clapper so that it will hang loosely upon the cross-rod. This may seem impossible, but with due care can be accomplished even with a straight-bladed knife.

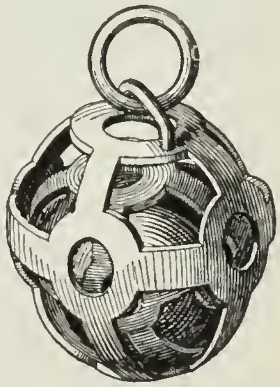


FIG. 8.

Two things only are to be observed in making it: the clapper may be cut near one side of the bell; when finally cut loose it will hang down in the middle, but if it is left there at first it is harder to cut the opening in the ring at its upper end since the sides of the bell prevent cutting in at much of an angle. Then, in hollowing out the inside of the bell, it is much better to cut with the edge of the knife, so far as possible, instead of with the point. This is accomplished by placing the point of the knife near the center of the bell, and then turning the bell in the fingers while pressing the edge of the knife against the part to be cut away. The large hollow of the bell is thus gradually deepened, and the work will always be kept smooth and neat. If one tries to work more rapidly by digging into the wood with the point of the knife, the inner surface of the bell soon becomes very rough and jagged. This should be carefully avoided.

Of course, care must be taken to leave a piece of wood near, but not quite against, one side of the bell, to form the clapper.

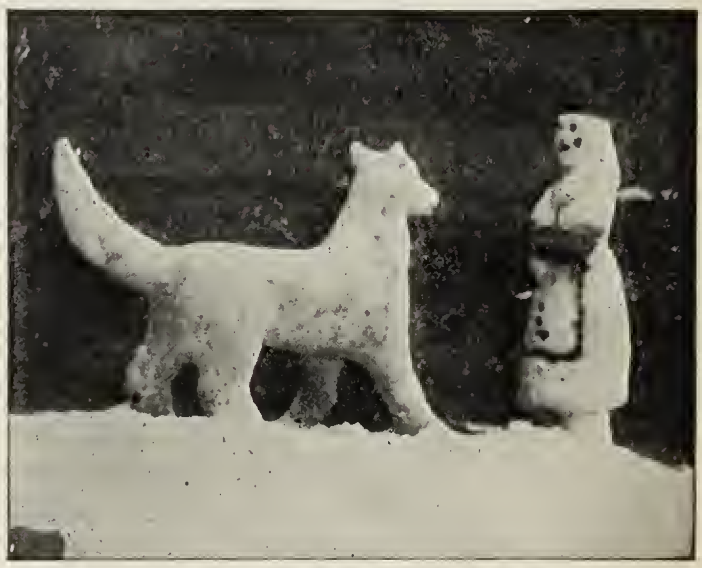
The most complicated piece of jack-knife carving which I have ever seen, is represented in Fig. 8. It consists of a solid ball surrounded by two hollow balls, or shells, and much resembles the curious series of concentric balls that the Japanese carve out of ivory. Many of my readers have probably seen specimens of these ingenious toys in museums. However complex and puzzling the design in Fig. 8 may appear, it is not really so hard to make as the bell. A pattern of the outer shell is traced upon a wooden sphere, which should be at least two inches in diameter, and the places where the openings are to be made are then dug out so that they form little pits, which should be a third to a half an inch in depth. The solid ball within is now cut loose from the shell as described above.

It would be very difficult and awkward to cut another such shell loose from the ball inside the outer one; but the same effect may be accomplished much more easily by dividing into an outer and an inner portion the shell already formed, which was made rather thick for this purpose. When this is successfully accomplished, the design is exceedingly effective, and persons who have not seen it made, and who naturally suppose that the shells have been cut one after the other from the solid ball, find it hard to believe that it could have been executed with a pocket-knife. The staple and ring represented at the top of the outer shell in Fig. 8, like the chain in Fig. 6, forms no essential part of the design and may be added or left off as found convenient.

SUGGESTIONS FOR SNOW IMAGES

The accompanying interesting illustrations are from photographs of snow sculpture made by the residents of Andreasburg, Germany, where each winter prizes are offered by the village authorities for the finest and most original designs in snow modeling. The pictures were taken of designs which have been made within the last few years. They all show considerable skill in modeling, and as snow is evidently plentiful, the making of these various forms must have meant good wholesome fun.

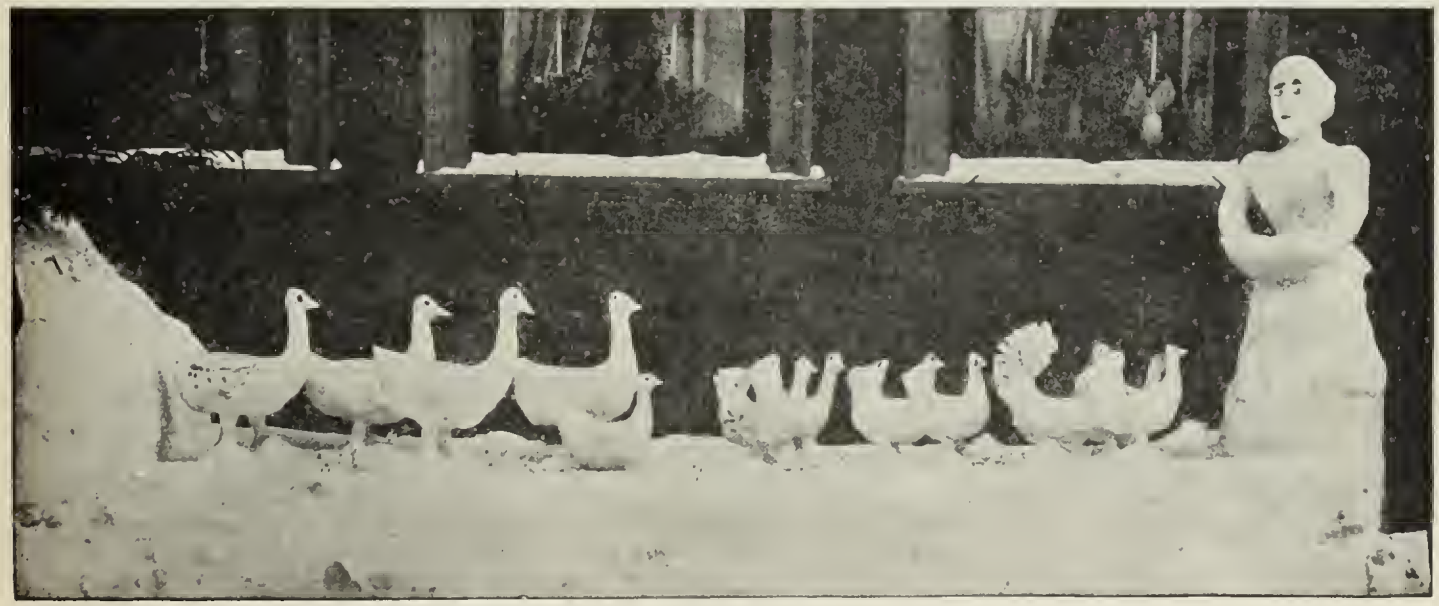
As a result of these yearly competitions, a sculptor may some day appear in this small village who will reflect honor upon his whole country. Out of such conditions, as we all know, many a famous man has sprung and produced works of genius for the enjoyment of the world.



LITTLE WHITE RIDING-HOOD AND A WHITE WOLF.
Both made of snow.

SNOW ANIMALS HOLD A NEW YEAR'S MEETING IN THE FOREST.

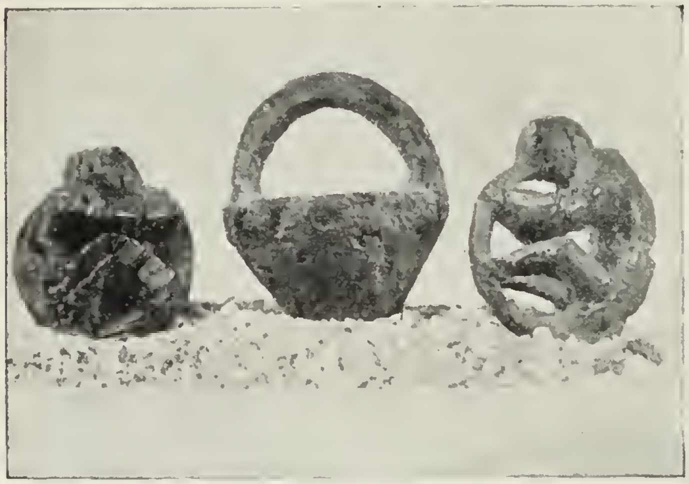
THE TROLLEY-CAR—NOT WELL HEATED, BUT BEAUTIFUL.



A SNOW-GIRL FEEDING FOWLS ON THE SNOW.

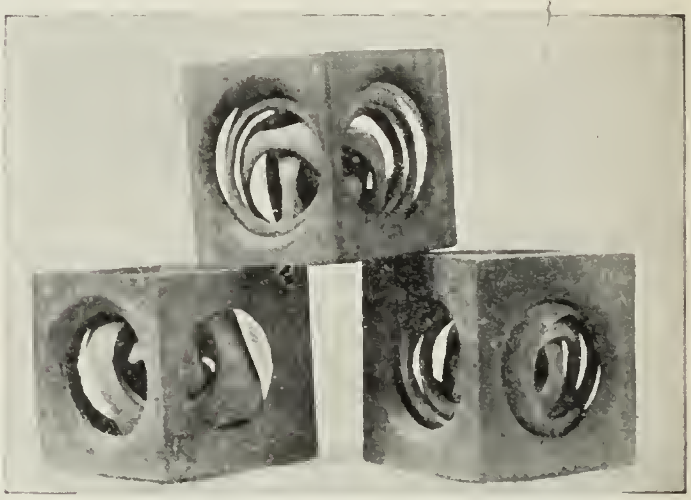
THE JACK-KNIFE AND ITS MANY USES

FROM my earliest boyhood I have been a user and lover of a good jack-knife, an implement that I have always taken pride in keeping in good condition. In making this statement, I am confident that I strike a chord of fraternal sympathy with the boys. I wish I could inspire every young person with a greater liking for the jack-knife. It is the best tool in all manual training methods; it is the inseparable companion of every nature lover, and it is the best "all round" piece of apparatus for scientific experimenting.



PEACH-STONE WHITTLING.

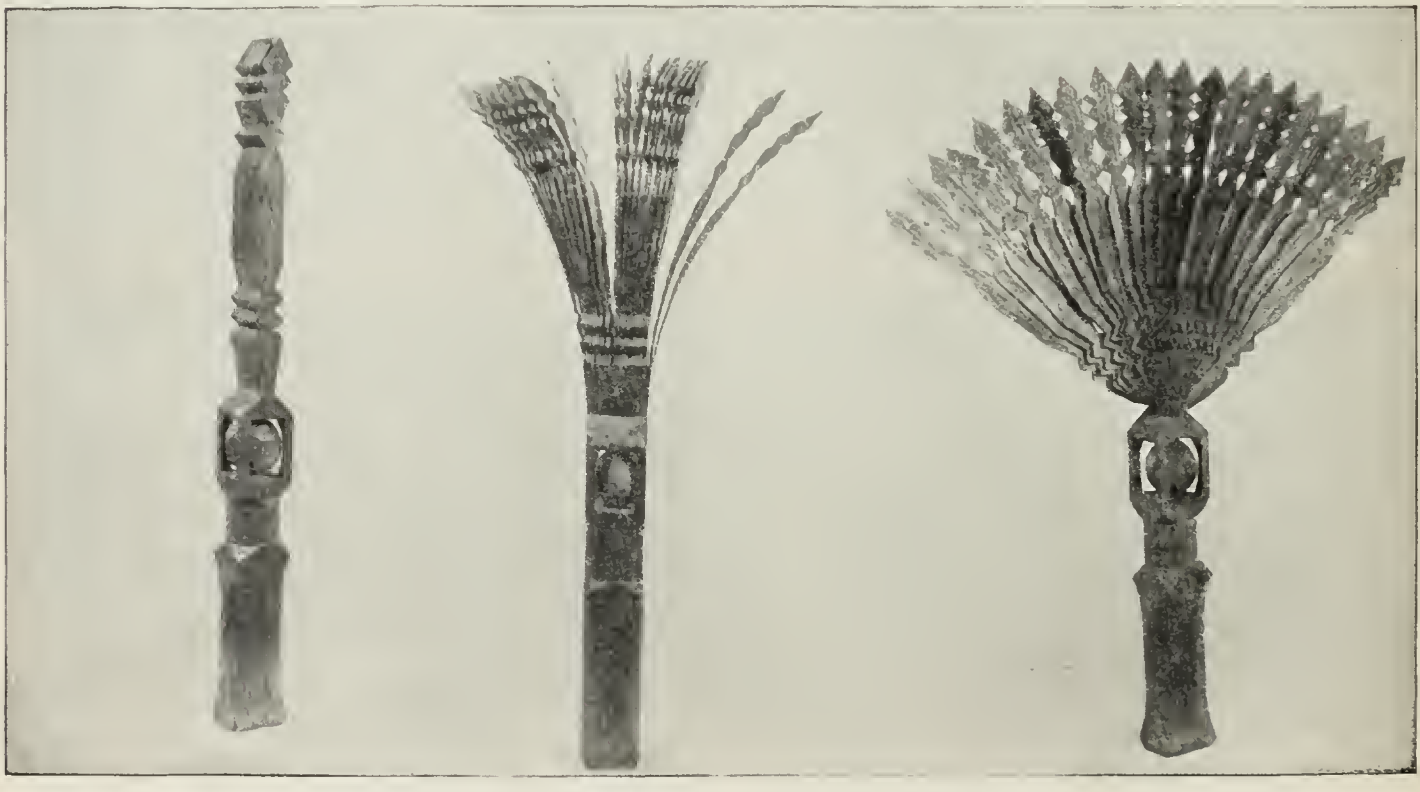
From left to right: First steps in whittling a monkey, a peach-stone basket, and a completed monkey (sitting with tail in mouth).



FAVORITE TESTS OF SKILL WITH JACK-KNIFE.

Movable rings within blocks.

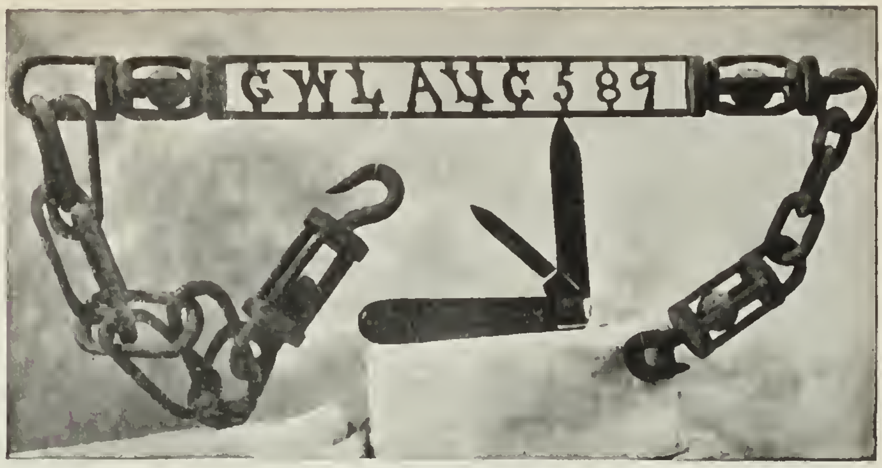
Not long ago, in talking to boys and girls in a school-room, I asked for an exhibition of their lead-pencils. The variety of wood-cutting there displayed was astonishing. Indeed, it was more than astonishing, for it was indescribably funny. And the best of it was that every pupil appreciated the joke, and laughed as heartily as I did. Perhaps some of our older readers will take this



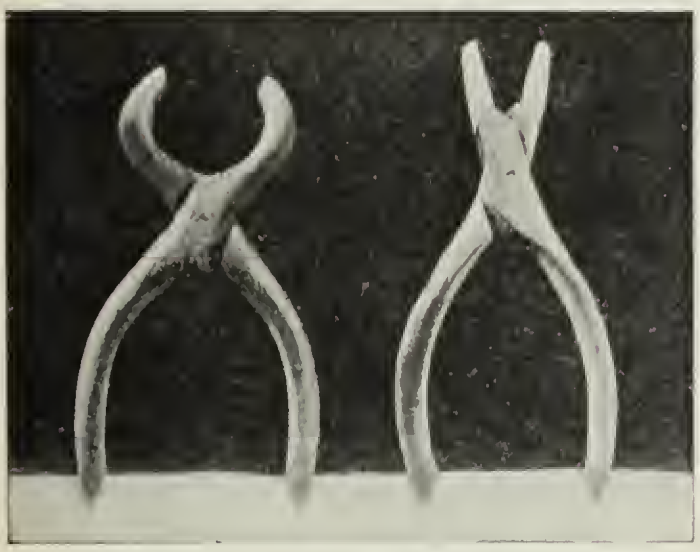
HOW TO MAKE A WOODEN FAN BY USE OF A JACK-KNIFE.

Shape a stick as shown in first illustration. Then, after soaking this in water, slit down as shown in the next illustration. Then pull apart the splints or "rays," *sideways*, and catch each in the notches of the other.

as a fertile suggestion, try it, and give themselves and their friends a good laugh. The funny part was not in the diversity of length, shape, and color, but in the sharpening. The "points" I wished to make were readily seen and thoroughly appreciated. They were long, short, slender, chubby, crooked, cragged, smooth, rough, beautiful, ugly—in truth, it would take more adjectives than the dictionary can supply to do them justice. No extended study of those pencil-points would be needed to tell much of their owners' dexterity. I think, too, that they expressed much of the owners' characteristics. I am certain that some exhibited thoughtful care, and others, thoughtless carelessness.

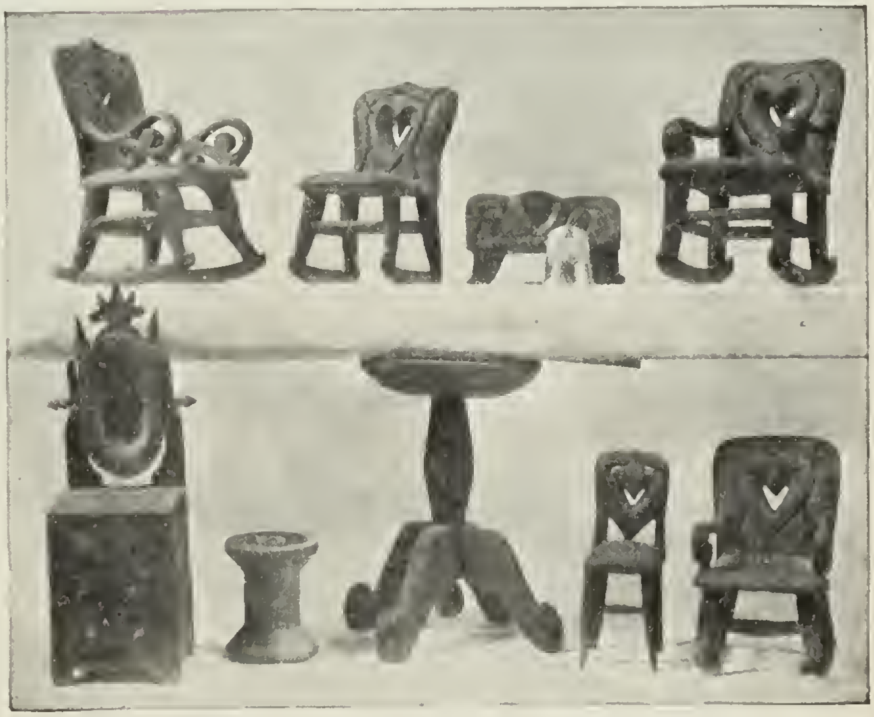


CHAIN, SWIVELS, AND NAME-PLATE.
All cut in one piece from a broom-handle.



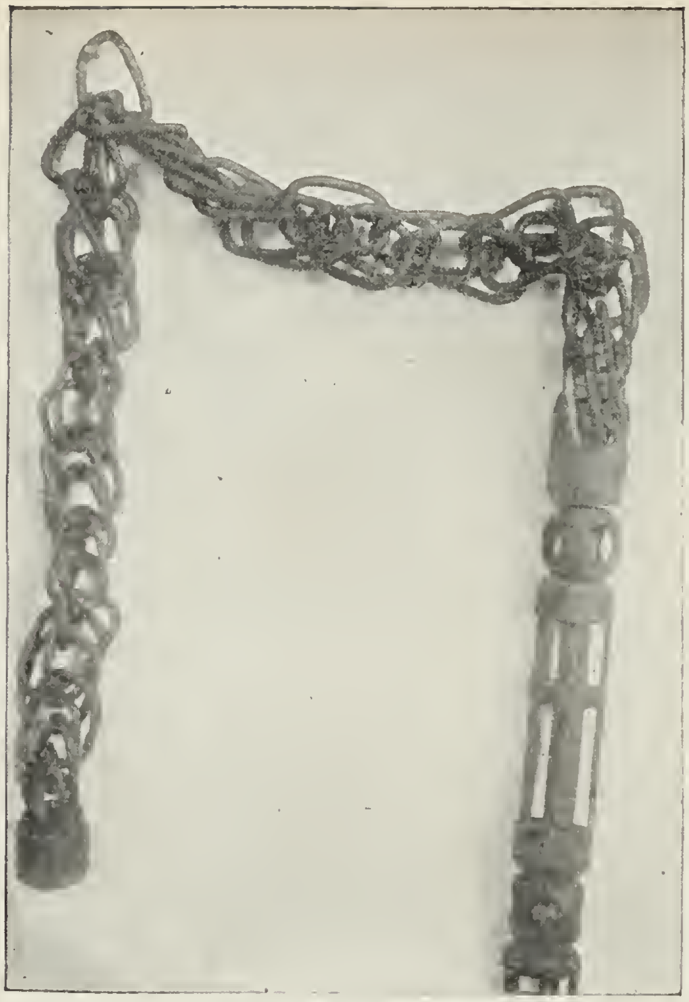
NIPPERS AND PLIERS.
Readily open and shut. Each from one piece of wood.

I remember that years ago, when I was a pupil in the High School, I thought that a boy sitting near me was foolishly "fussy" with his pencils, crayons, and drawing materials, and especially so with a piece of stout cord used in drawing circles on the blackboard for the use of the class in geometry. He had the end of this cord carefully wound into a hangman's knot, and he "slip-noosed" it so carefully and skilfully around the end of a crayon that the other members of the class were greatly amused. I remember that after every recitation he carefully wound the cord around his finger, slipped off the coil and put it in a box especially provided for the purpose. The boys and girls sometimes ridiculed him for this, as well as for the careful sharpening of his pencils. When in the woods he always cut a walking-stick with the same exquisite care. I remember that the teacher commended his circles and other geometrical figures. They often looked better than those in the book. In later years I have noted that his life's work is better done than that of most of the other members of the class. Yes, a jack-knife or even the sharpening of a pencil shows something of character. Let them both be the best possible.



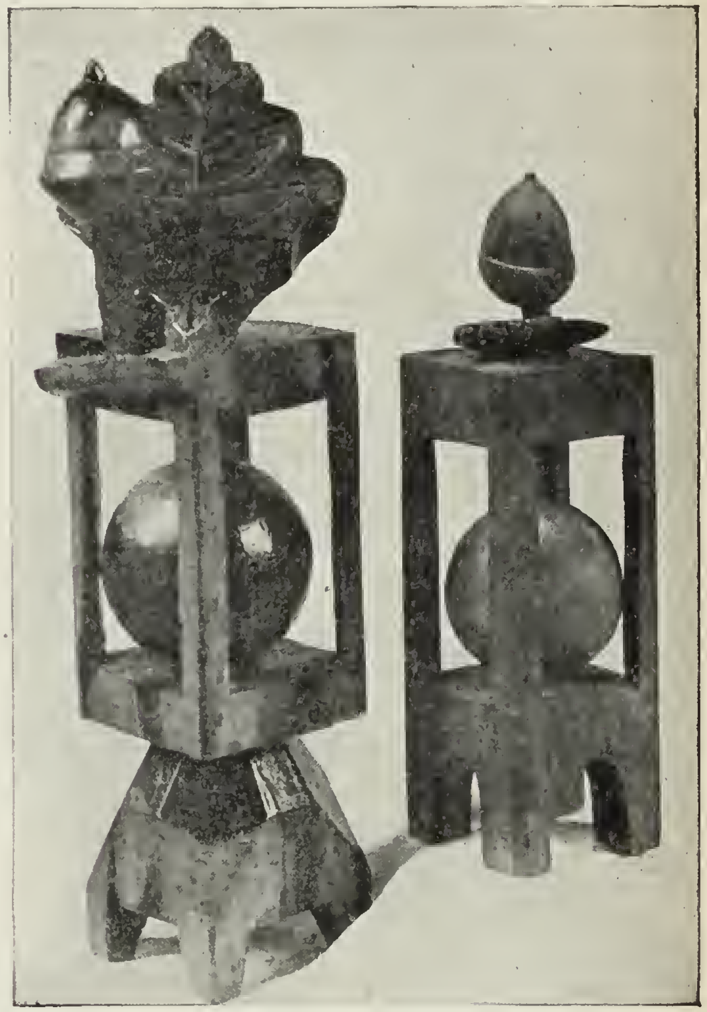
DOLL'S FURNITURE. EACH PIECE CUT FROM ONE BLOCK.
Photographed with thimble and spool to show comparative size.

Young people in the country and all nature lovers find many uses for a sharp jack-knife. With it the smaller parts of plants may be dissected, samples of woods may be selected and



INTRICATE LINKED CHAIN.

smoothed to show the grain, souvenirs may be cut and carved. The woodsman, especially the New England woodsman, is proverbially a whittler, and through practice he becomes exceedingly expert in the use of the implement. For those who do especially skilful whittling, the favorite tasks are to make concentric rings within cubes of wood, to originate furniture, fans, chains from broomsticks, and peach-stone baskets. Some of these broomstick chains become intricate by innumerable interlocking links. A favorite exhibition of skill is to cut, from a single piece of wood, a pair of nippers or pliers so that they may be actually opened and closed. To carve a swivel or a movable ball within four column-like supports is another favorite form.



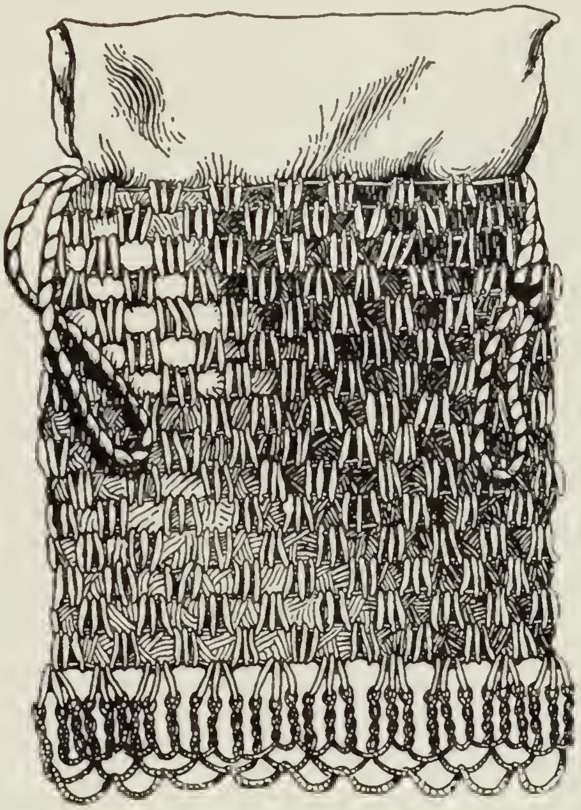
BLOCK WHITTLING.
Movable ball, acorn, and leaf.

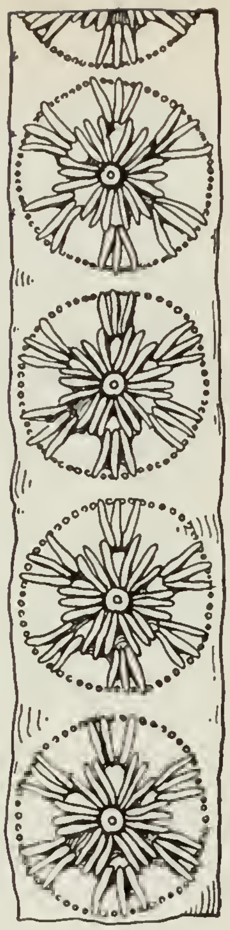
ARTICLES MADE OF MELON SEEDS

The seeds of a watermelon or a muskmelon must be well washed and thoroughly dried. The other materials required are gold beads, needle, and thread. Our sketches show a bag and part of a belt.

For seeds of a muskmelon, some gold beads are required, and fine gold-colored purse-silk. On the first needleful of silk string eighteen seeds of equal length, piercing through the pointed end of the seed. Draw them together and pass the needle again through the first seed, thus forming it into a circle. Now carry the silk up to the round end of the seed, put the needle through, and string on one small bead; then pass the needle through the next seed, another small bead, through the next seed, and then string on three more seeds at their pointed ends. Repeat this until you have gone quite around, making groups of three seeds after every third seed of the first eighteen. When this is done, securely fasten and carry the silk up to the round end of the first group of three, pierce through these three with one small bead after each seed, eight or nine beads between the groups of three, and so on till the outer circle is finished; fasten off neatly and securely, and sew one of the larger beads in the center of the rosette. Make as many of these rosettes as required; usually about fourteen are needed for a waist measuring twenty-five inches. Sew them neatly on a foundation of ribbon or velvet, but should either be limp, a stiff lining of canvas will be necessary.

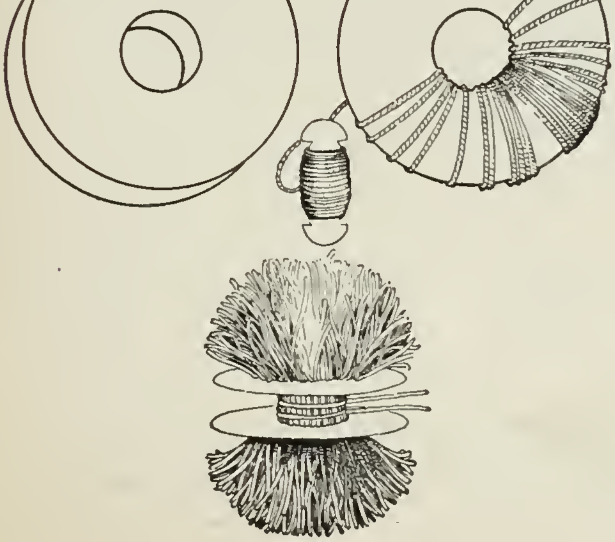
Having made this, it will be much more simple to form the bag with the picture alone as guide; but when the seeds are strung together and a fringe of beads is made, the bag should be lined with silk. Beads and spangles may be mixed with the seeds.





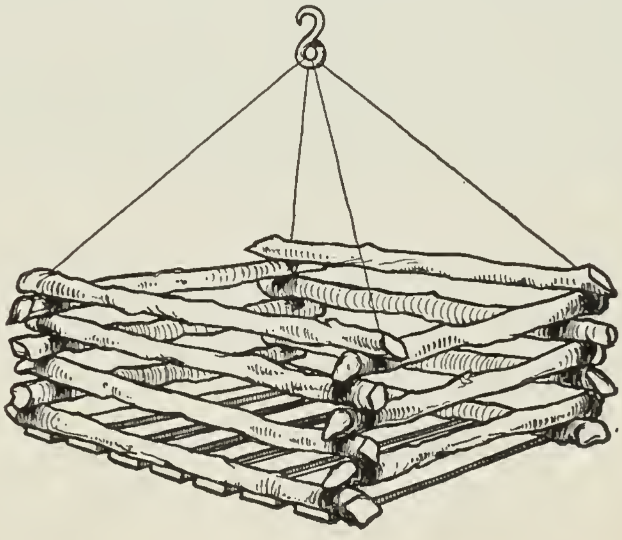
A WOOL-BALL FOR A BABY

Out of cardboard cut two circles about three inches in diameter, and in the center of each of these cut a circular hole about one inch in diameter. Now take any bright colored worsted and wind it round and round the cardboard rings as shown. The center hole should be filled very solid with worsted, even though the last part of the winding has to be done with long needlefuls of worsted on darning-needles. The fuller the ring the better shape the ball will be. When it is not possible to get any more wool on, take a pair of sharp-pointed scissors and cut round the outer edge of the cardboard ring. The wool will spring away toward the top and bottom, showing the two cardboard rings inside. Pull them gently apart and tie the wool that can be seen between them with a strong piece of twine, as tightly as possible. Break away the cardboard and clip into shape.



A HANGING FERN-BASKET

Collect sixteen, twenty, or twenty-four smooth, tough little sticks of about equal thickness and cut them into pieces eight inches long. One inch from each end of the twenty-four sticks bore a little hole, being careful not to split the wood. What now remains to be done is shown in the sketch, namely, to string the pieces on wires.

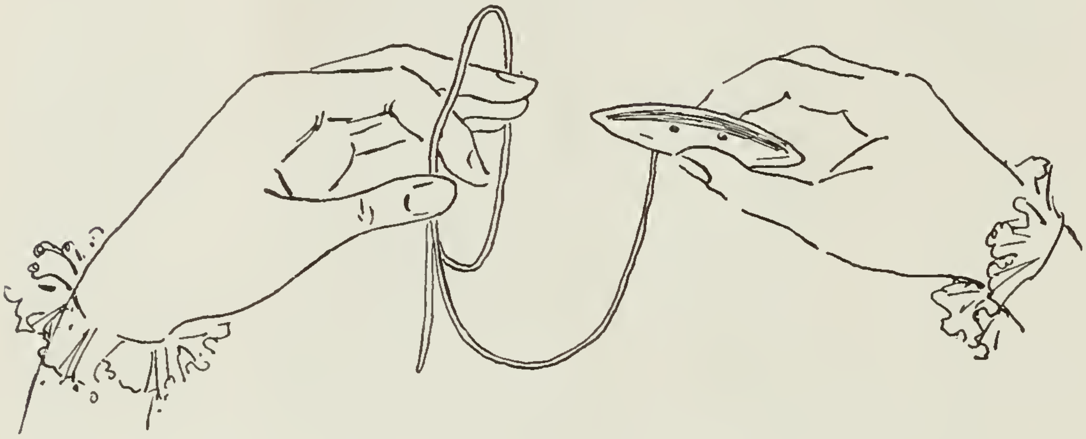


TATTING

BY HELEN MARVIN

Tatting is such a pretty and simple kind of needlework that every little girl ought to learn how to do it, for it is nothing but a lot of buttonhole stitches made on a thread with a shuttle, instead of on cloth with a needle. There is only one important point about it, and of that I shall tell you later.

When you wish to begin to tat, you must have a shuttle filled with thread. A tatting-shuttle has a cube-shaped inside, inclosed in two long side-pieces that meet at the pointed ends. The cube center has a hole bored through it, and through this hole the end of the thread is passed, then knotted around the cube. After that the shuttle is filled with thread wound around the center cube, and to do this the thread must be slipped in each time between the pointed ends. If the thread for tatting were put on an ordinary spool or shuttle it would slip too easily, and would quickly tangle.

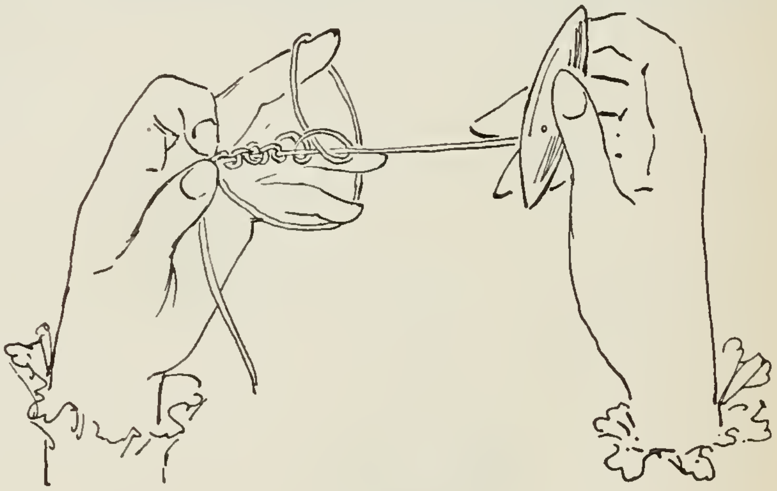


NO. I. HOW TO HOLD THE SHUTTLE AND THREAD.

The easiest pattern in tatting is the single edge which you see in the picture and which we shall now begin to make. Picture No. 1 shows how to hold the shuttle and how to throw the thread in a ring over the left hand. This is done by holding the end of the thread between the thumb and the first finger, with the inside of the hand down and the end of the thread hanging down, too. Pass the thread over the top of the fingers, down and around the inside of the fingers, and again between the thumb and the first finger. This makes what is called the ring.

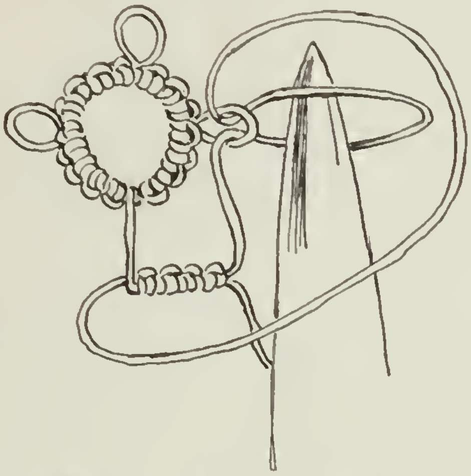
Begin to make the buttonhole stitch, and picture No. 2 will show how this is done. Each stitch is in two parts and is called a double-stitch in all directions for tatting. This double-stitch is worked as follows: Throw the thread around the top of the hand behind the ring and pass the shuttle from the tips of the fingers beneath the ring and out between the ring and the new thread over the hand. After that is done carry the thread and the shuttle with a quick jerk to the right, so that that part of the thread is straight and tight. If this has been done quickly and tightly enough, you will see that the stitch is going to be formed with the thread of the ring and not with the shuttle thread, as those of us who do not know would suppose. This is the very important point about tatting I told you of. The stitches must be formed with the ring-thread, or, when all your stitches are made, you will find that you cannot pull the ring into a round shape. So when you tat be sure your stitches are made with the correct thread.

After the stitch is formed with that quick jerk of the shuttle thread, with your forefinger lift the thread over it, tighten the stitch and put it in place. You can do this after a little practice. Never have the ring too large, for with a large ring it is much harder to get the stitches in place.



NO. 2. THE "BUTTONHOLE" STITCH.

To make the second part of the double-stitch, let the thread between the shuttle and ring hang down in front of the work, and pass the shuttle under the ring from the back of the hand toward the tips of the fingers and out between the ring and the hanging thread. Again jerk the thread and the shuttle and form the stitch; this completes the double-stitch. Make 4 double-stitches, then make a picot, which is the name of the little loop of thread one sees in tatting. To form this picot make a double-stitch, but when drawing it up do not put it close to the stitch before it, but leave a little space between. When drawn up, this forms the loop. Make 16 double-stitches in all in the ring, with a picot after every fourth stitch. Then take the ring off the fingers, hold the first stitch between the thumb and first finger and draw the shuttle thread until all the stitches are close together and the ring is formed.



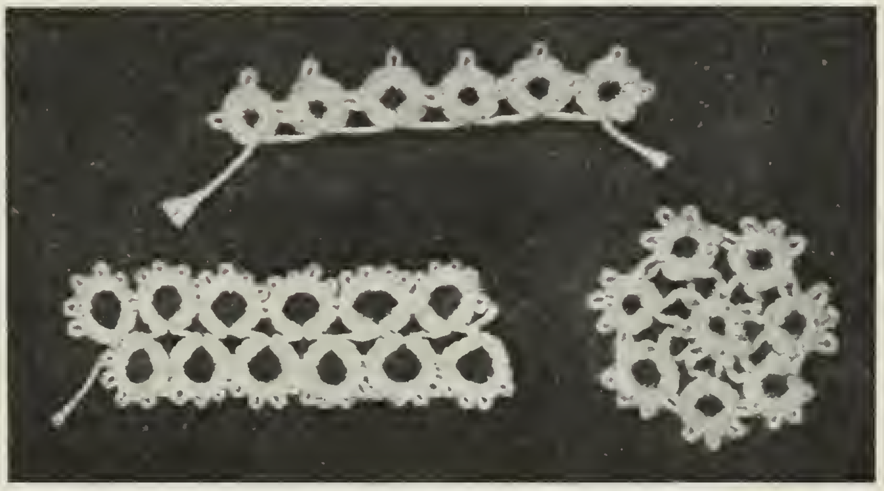
NO. 3. JOINING THE RINGS.

All the rings of the edge are made like this excepting that they are joined. Always begin each ring about an eighth of an inch away from the ring before it, and when four double-stitches are made join the ring to the ring before it, shown in picture No. 3, in this way: Pull the ring thread in a big loop through the last picot of the preceding ring. You can do this easily with a large pin. Now pass the shuttle through this loop, and draw the loop up just as though it were a stitch. This joining takes the place of the first picot of the ring.

The insertion, shown in the picture, is just as easy to make as the edge and is made in almost the same way. Each ring has 5 double-stitches to start it, then a picot and 2 double-stitches made over and over until there are 5 picots, and after that 5 double-stitches to finish the ring. A ring is made first for one side of the insertion and then for the other side, so do not join the second ring to the first. Join the third ring to the last picot of the first ring, the fourth ring to the last picot of the second ring, and after that join a ring first to one side and then to the other. This forms a pretty insertion.

The medallion is made almost like the edging, too. Begin with a ring for the center. Make 1 double-stitch, then make a picot and 2 double-stitches over and over until there are 7 picots, and finish the ring with 1 double-stitch. After the ring is pulled tight, pull a loop of the thread next to the ring through the first picot, and join just as though you were joining 2 rings together, leaving about an eighth of an inch of thread between the ring and the joining.

An eighth of an inch along the thread from this joining make the first ring for the edge. These edge rings are made just like those of the insertion and each ring is joined to the last picot of the edge ring before it. Between the rings the thread is joined always to the next picot of the center ring. An eighth of an inch of the thread must be left at each side of each joining. When you make the seventh ring around the edge, instead of making the last picot, join the ring to the first picot of the first ring. After the seventh ring is finished, once more join to the first picot of the center ring, and cut the thread.



EDGING.
INSERTION. MEDALLION.

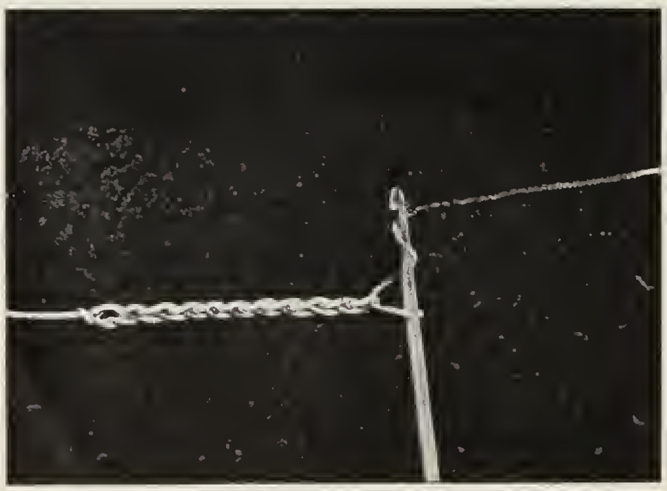
HOW TO CROCHET

BY HELEN MARVIN

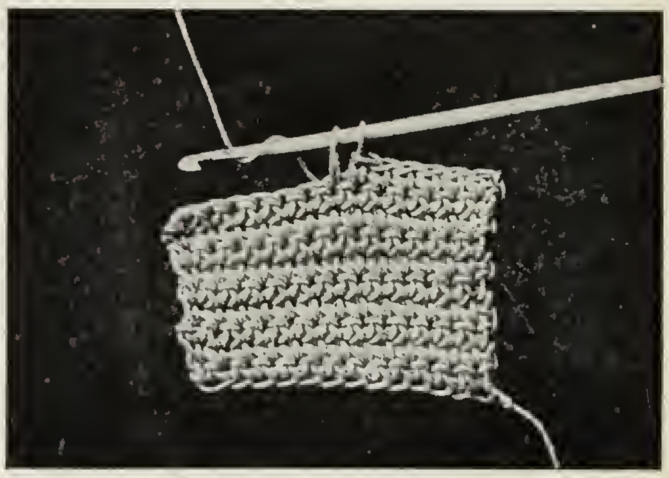
To know how to crochet one must learn only three simple stitches which any little girl or boy can make. These three simple stitches are the chain-stitch, the single-crochet stitch, and the double-crochet stitch. Chain-stitches are the stitches of the string made to start almost any piece of crocheting, and in most printed directions you will find their name shortened to ch.

To begin, hold the crochet hook just as you would hold a pen, and in the left hand hold the thread, winding it over and between the fingers so you can loosen or tighten it as you wish. The best way is to throw it over the first finger, let it run between the first and the second fingers, and hold it in the palm of the hand with the tip of the little finger. If you want the thread quite tight wind it two or three times around the first finger, and do not have too much thread between the crochet-hook and the first finger, because if you do that it is hard to crochet and it is hard, too, to keep your stitches even.

When you have the thread and the crochet-hook in place, throw the end of the thread over the crochet-needle, twist the two sides together beneath the needle and hold this twist with the thumb and the first finger of the left hand. Holding it in this way, with the hook take up a loop of the thread running to the left hand and pull this loop through the loop on the needle, the twist of which you are holding. Let go the twist and pull the end of the thread beneath. This tightens the first stitch. Draw one loop after another through the loop on the needle, until you have made as many chain-stitches as you need.


CHAIN STITCH.

To make the single-crochet stitch, which in most printed directions is spoken of as s. c., you must have a string of chain-stitches or some other foundation upon which to work them. Let us work them on the string of chain-stitches you have just learned how to make. Put the hook in the second chain-stitch from the needle, and draw a loop of the thread through it, just as though you were making a chain-stitch. This gives 2 loops on the needle. Draw a loop of the thread through these 2 loops. When this is done the first single-crochet stitch is finished. Make 1 single-crochet stitch in each of the chain-stitches all along the string, and when you have done so the first row of single-crochet stitches is finished.


SINGLE CROCHET.

For the second row of single-crochet stitches the work must be turned so that the wrong side of the stitches of the first row is toward you. When this has been done pick up a loop in the first single-crochet stitch next to the needle. This can be done in two ways. You can put the hook in beneath the two threads which form the top of the stitch and look so much like a chain-stitch, or you can take up the loop on one thread, that which is farthest away from you. If the stitch is taken up on two threads your work will be flat, and if on one thread it will be ribbed. Aside from this picking up, the stitches are made the same as those of the first row, and all the other rows are made like the second row.

The double-crochet stitch, called d. c. in printed directions, is made a good deal like the single-crochet stitch. There is only this difference: Throw the thread over the needle before picking up a loop in the chain-stitch, which gives

3 loops on the needle, instead of 2 loops. Draw the thread through 2 loops, which leaves 2 loops on the needle. Draw the thread through 2 loops.

DOUBLE CROCHET.

This finishes the first double-crochet stitch and all the others are made like it.

There are two other points that must be learned. One is how to fasten off crocheting, and this is very simple, for all you need do is to make a chain-stitch after the last stitch of the work, cut the thread about three inches away from the chain-stitch, pull the loop on the needle until the end comes through, and draw this end tight. The second point which one must learn is what a ♯ means in these directions. It means that that part of the work must be repeated. When you first come to a ♯ take no notice of it; by and by you will come to a second ♯, telling you to repeat from ♯. That means to go back to the first ♯ and repeat from there.

Now that we have learned the stitches let us make some of the pretty patterns in the pictures, and in giving directions for them remember that we speak of a chain-stitch as ch, a single-crochet stitch as s. c., and a double-crochet stitch as d. c.

NARROW EDGING

Begin with 12 ch. Turn and make 1 d. c. in the eighth ch from the needle, ch 2, 1 d. c. in the last ch of the string.

Second row—Turn, ch 8, 1 d. c. in second d. c. along preceding row, and 10 d. c. worked in the ring at the end of that row.

Third row—Turn, ♯ ch 5, 1 s. c. in second d. c., and repeat from ♯ until 4 loops are made along the preceding row. Ch 5, 1 d. c. in last d. c., ch 2, 1 d. c. in the third stitch of the ch.

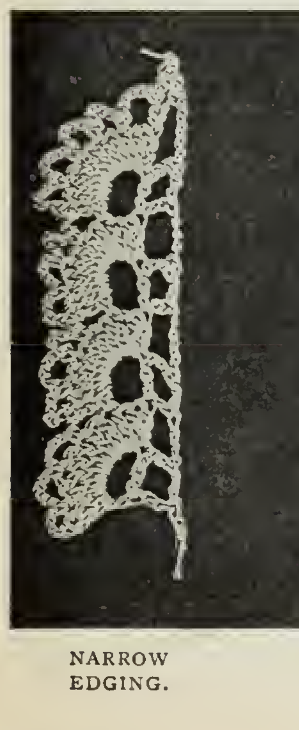
Repeat the second and third rows over and over, until the lace is long enough.

FILET CROCHET INSERTION

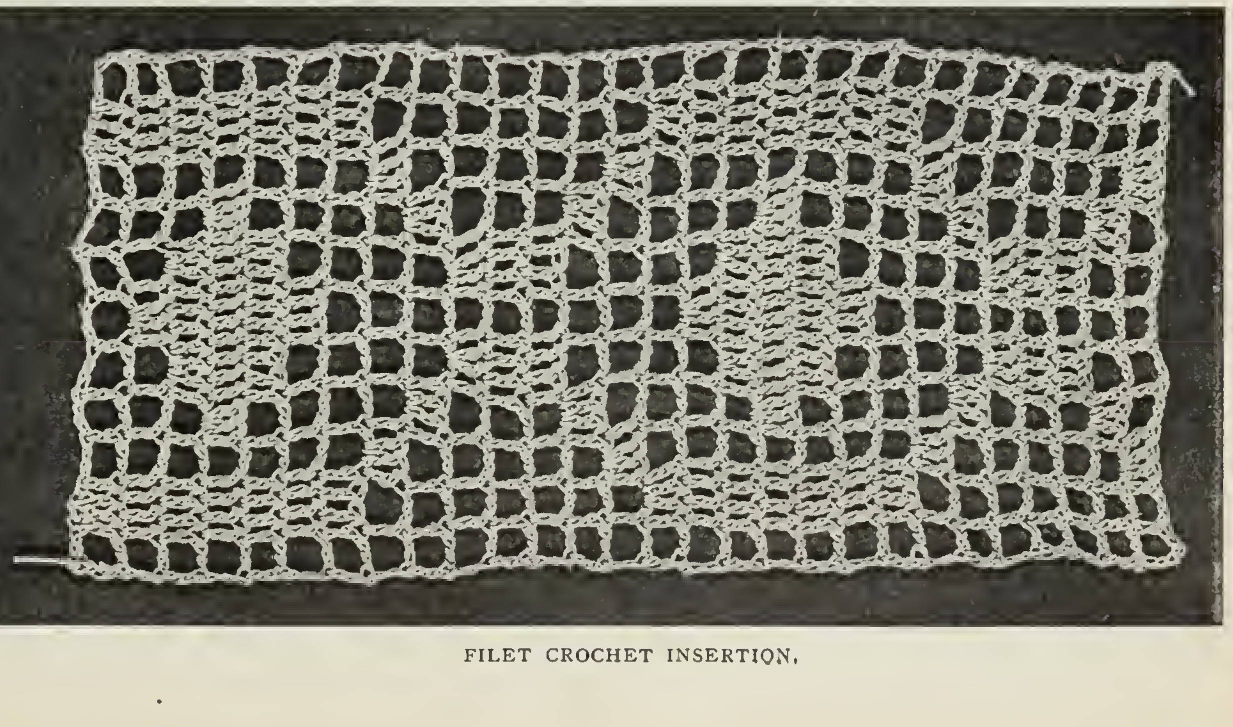
Begin with 38 ch.

First row—1 d. c. in the eighth ch from the needle, 1 d. c. in each of the next 3 ch, ♯ ch 2, skip 2 ch of string, 1 d. c. in the next. Repeat from ♯ until 7 holes are made. Make 1 d. c. in each of the next 3 ch, ch 2, skip 2 ch of string, 1 d. c. in the next.

All the rows are begun with 5 ch which, with the d. c. made after them, form the first hole, and after this, when the directions say to make a certain number of d. c., the d. c. made to close the last hole is included in the amount given.



NARROW EDGING.



FILET CROCHET INSERTION.

To make a hole work 2 ch and 1 d. c. after them.

Second row—Turn, ch 5 and make 1 d. c. in the second d. c. for the first hole of the row, 2 d. c. worked in the next hole and 1 d. c. in the next d. c.; ch 2, 1 d. c. in the next d. c. to form a hole, 2 more holes, 4 d. c., 3 holes, 4 d. c., 1 hole.

Third row—Turn and make 1 hole, 4 d. c., 2 holes, 10 d. c., 2 holes, 4 d. c., 1 hole.

Fourth row—1 hole, 4 d. c., 1 hole, 16 d. c., 1 hole, 4 d. c., 1 hole.

Work the fifth row like the third row, the sixth row like the second row, and the seventh row like the first row.

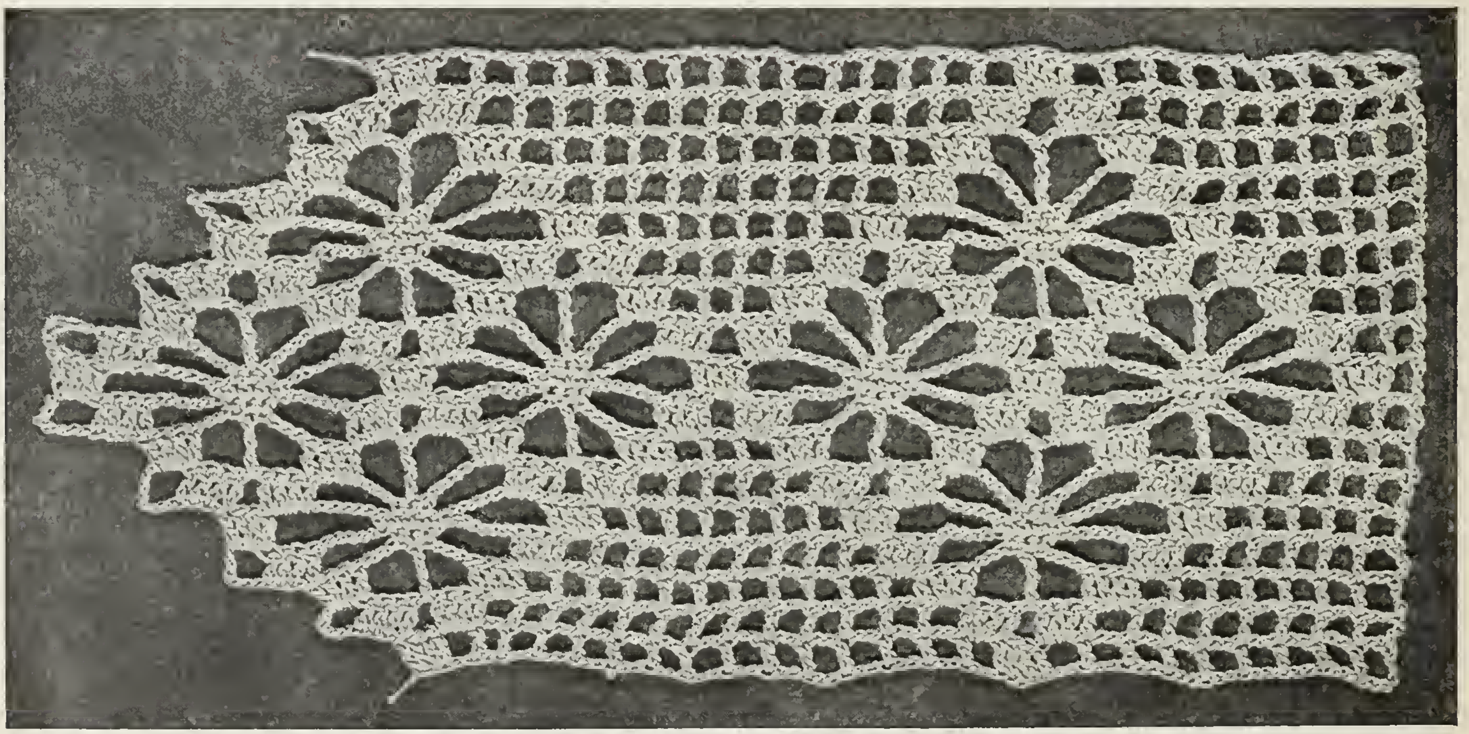
Eighth row—Turn and make 2 holes, 4 d. c., 5 holes, 4 d. c., 2 holes.

Ninth row—3 holes, 4 d. c., 3 holes, 4 d. c., 3 holes.

Tenth row—4 holes, 4 d. c., 1 hole, 4 d. c., 4 holes. Repeat the tenth row twice, then repeat the ninth row, and after that repeat the eighth row. This is the last row of the pattern. Repeat from the beginning of the first row, to make the insertion as long as you wish.

SQUARE LACE

To make this lace a new stitch must be learned—the treble-crochet stitch. It is not hard, for it is made just like the double-crochet stitch excepting that the thread is wound around the needle twice, before taking up a loop in the chain-stitch. That gives 4 loops on the needle. Draw the thread through 2 loops, and that leaves 3 loops on the needle. Draw the thread through 2 loops, and that leaves 2 loops on the needle. Draw the thread through 2 loops, and that finishes the treble-crochet stitch. In printed directions the treble-crochet stitch is called the treble.



SQUARE LACE.

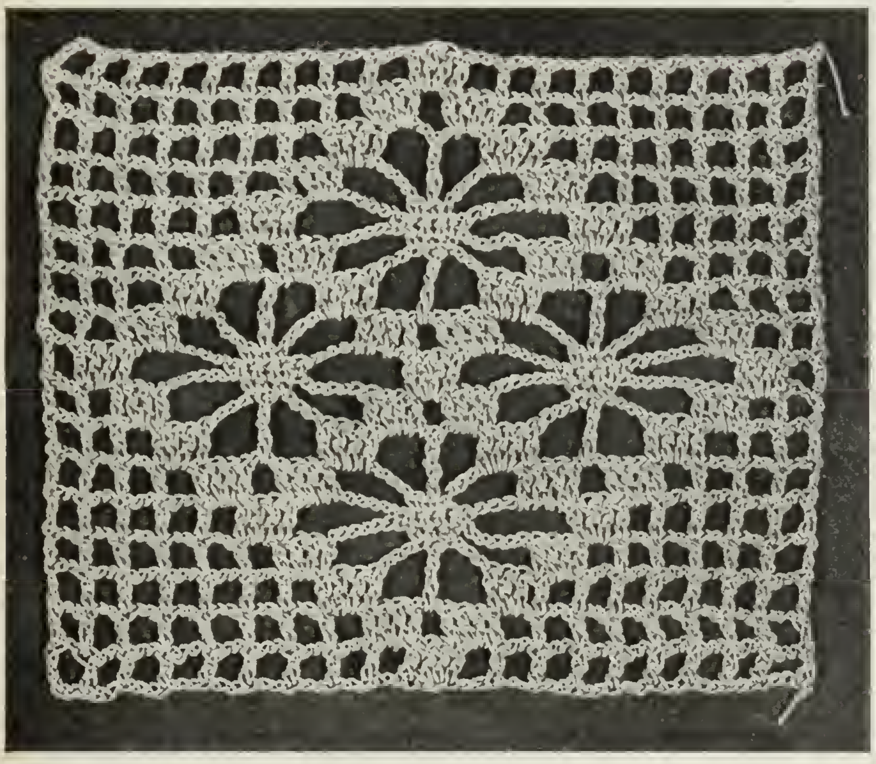
Having learned how to make the treble-crochet stitch, let us begin the lace. Start with 83 ch, turn and make 1 d. c. in the eighth ch from the needle. This is the first hole at the top of the lace. ♯ Ch 2, skip 2 ch of string, 1 d. c. in the next. Repeat from ♯ until there are 9 holes in all in the row. Make 1 d. c. in each of the next 3 ch, work 15 holes along the row, then make 1 d. c. in each of the last 3 ch.

Second row—Ch 12 and turn, make 1 d. c. in each of the last ch from the needle, and 1 d. c. in the first d. c. Ch 1, make 3 d. c. in the first hole of the preceding row, 1 d. c. in the next d. c. Make 13 holes along the row. When they are made work 2 d. c. in the next hole of preceding row and 1 d. c. in the next d. c. Ch 1, 1 d. c. in the last d. c. of the group of preceding row, 2 d. c. in the next hole, and 1 d. c. in the next d. c. Work 8 holes to the top of the lace, working the last d. c. in the third stitch of the ch.

Third row—Turn, ch 5 and make 1 d. c. in the second d. c. of preceding row, then work 6 holes more along the row, 2 d. c. in the next hole, and 1 d. c. in the next d. c. Ch 4, 1 treble in the space between the two groups of preceding row, ch 4, 1 d. c. in last d. c. of second group, 2 d. c. in hole, 1 d. c. in next d. c. Work 11 holes along the row, then make 4 d. c., 4 ch, 1 treble, 4 ch, and 4 d. c., working as before.

Fourth row—Ch 12 and turn, 1 d. c. in each of the last 3 ch, and 1 d. c. in the first d. c. of preceding row. Ch 7, 1 s. c. in ch before treble, 1 s. c. in treble, 1 s. c. in ch after treble. Ch 7, 1 d. c. in last d. c. of group, 2 d. c. in next hole, 1 d. c. in next d. c., 9 holes, 2 d. c. in next hole, 1 d. c. in next d. c., then ch 7, make 3 s. c., ch 7 and make a group of 4 d. c., working as before. Finish the row with 6 holes.

Fifth row—Start the row with 5 holes, 2 d. c. in hole, 1 d. c. in next d. c. Ch 8, 1 s. c. in ch preceding first s. c., 3 s. c. on s. c. of preceding row, 1 s. c. in next ch. Ch 8, 1 d. c. in the last d. c. of the group, 2 d. c. in hole, 1 d. c. in next d. c. Work 7 holes, make a group of 4 d. c., then work the ch and 5 s. c. as before, and finish the row with a group of 4 d. c.



SQUARE INSERTION.

Sixth row—Ch 12, turn, and make a group of 4 d. c. in the usual way. Ch 1, 1 d. c. in last d. c. of group of preceding row and 3 d. c. over the ch. Ch 7, 1 s. c. in each of the center 3 s. c., ch 7, 3 d. c. over the ch and 1 d. c. in first d. c. of group of preceding row, ch 1, 1 d. c. in last d. c. of group, 2 d. c. in hole, 1 d. c. in next d. c. Work 5 holes along the row, make a group of 4 d. c., ch 1, make another group, then work in ch and s. c. as before, and make 2 groups and 4 holes to finish the row.

Seventh row—Turn, 3 holes, ‡ group of 4 d. c., ch 4, 1 treble in space between groups of preceding row, ch 4, 1 d. c. in last d. c. of group, 3 d. c. over ch, ch 4, 1 treble in center s. c., ch 4, 3 d. c. over ch and 1 d. c. in first d. c. of group, ch 4, 1 treble in space between groups, ch 4, 1 d. c. in last d. c. of group, 2 d. c. in hole, 1 d. c. in next d. c., make 3 holes, and repeat from ‡. The row is ended with a group made after the last 4 ch.

Eighth row—Ch 12, turn, and make 1 group as usual. ‡ Ch 7, 1 s. c. in ch before treble, 1 s. c. in treble, 1 s. c. in stitch after treble. Ch 7, 1 d. c. in last d. c. of group and 3 d. c. over ch, ch 1, 3 d. c. over next ch, 1 d. c. in first d. c., repeat from ‡, making 1 group and 2 holes to end the row.

Ninth row—Turn, make 1 hole, 1 group, ‡ ch 8, 5 s. c. over s. c., ch 8, 1 group between the groups, and repeat from ‡ to the end.

Tenth row—Work like the eighth row, but begin with 5 ch instead of 12 ch, and work the first group of the row after that of the preceding row, instead of before it. Then repeat the seventh row, and the sixth, and work back on all the rows in this way, always turning at the bottom with 5 ch instead of 12 ch. When the first row has been repeated one point of the lace is made. Repeat from the beginning of the second row, over and over, for the length of lace that is needed.

SQUARE INSERTION

Start with 62 ch, turn, and work like the first row of the lace, but with 9 holes, 4 d. c., 9 holes.

Second row—8 holes, 1 group of 4 d. c., ch 1, group of 4 d. c., 8 holes. On this row the directions for the lace may be carried out, making only the top series of squares, and having the rows end, both top and bottom, like the top of the lace.

CENTERPIECE

The work in this crocheted centerpiece is different from any we have had, because it is begun at the center and the crocheting is done in rounds instead of in rows. Begin with 8 chain stitches, and when they are made draw a loop of the thread through the first ch made and the loop on the needle. This forms a ring for the middle of the centerpiece. The end of each round of the work is joined to the beginning just as this center ring is joined, and this joining stitch is called a slip-stitch in crochet.

First round—Ch 2, make 28 d. c. in the ring. Join the round. Do not turn the work when the round is finished, as you would if you were working in rows.

Second round—Ch 5, 1 d. c. in the second stitch of the preceding round, ‡ ch 2, again skip a stitch and make 1 d. c. in the next, and repeat from ‡ all around. At the end, after the last d. c., ch 2 and join to the third stitch of the starting ch.

Third round—In every second hole all around make 2 d. c., ch 2, 2 d. c. This group is called a shell. Between the shells ch 3. Work the fourth round like the third, but put 4 ch between the shells.

Fifth round—Work slip-stitches to the center of the first shell, and ch 2 to start the round, make 19 d. c. in the center of each shell, and between the shells work 1 s. c. This s. c. is worked around the two chains of the preceding rounds.

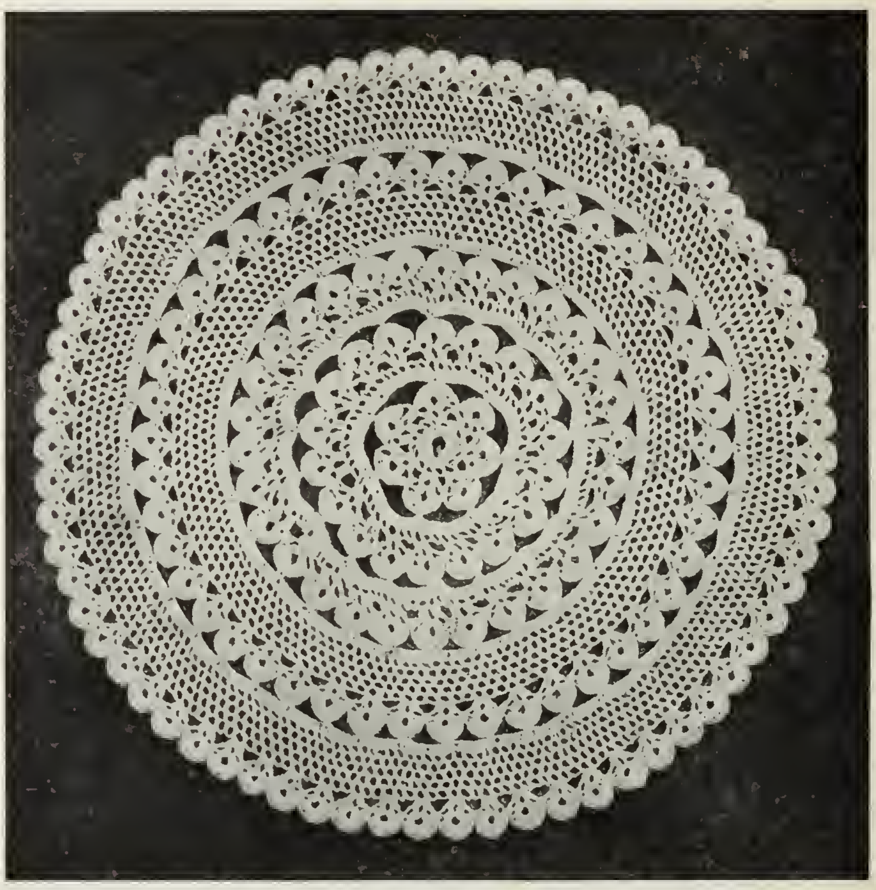
Sixth round—Put 1 s. c. in the center of each shell, and between the shells work 12 ch.

Seventh round—Make 15 d. c. over each ch loop. Over three of the loops work 16 d. c. instead of 15 d. c., to give the right number of stitches for the next round. Repeat the second round, then repeat the third round, but make the shell in every third space, instead of every second space. Now repeat from the beginning of the fourth round until the seventh round has been worked 3 times. Now work 1 round like the second round, but make 1 ch instead of 2 ch between the d. c., then work in the same way 4 times more, with 2 ch between. Repeat the third, fourth, and fifth rounds, then repeat the last ten rounds. Fasten off at the end.

CROCHETED DUTCH COLLAR

This collar is made in two halves, and each half is begun at the front end. The rows are worked up and down. Ch 38 to begin, turn, skip the first ch, make 1 s. c. in each of the others, 37 s. c. in the row. Make 2 rows more of 37 s. c. each, picking up the stitches on the double thread, so that no rib is made.

Fourth row—Turn, ch 6, ‡ skip 3 stitches of the preceding row, and make 3 d. c. in the next stitch. Ch 1, and repeat from ‡ until 8 groups of 3 d. c. each have been made along the row. Ch 1, skip 1 stitch, and make 1 d. c. each in the last 4 stitches.



CENTERPIECE.

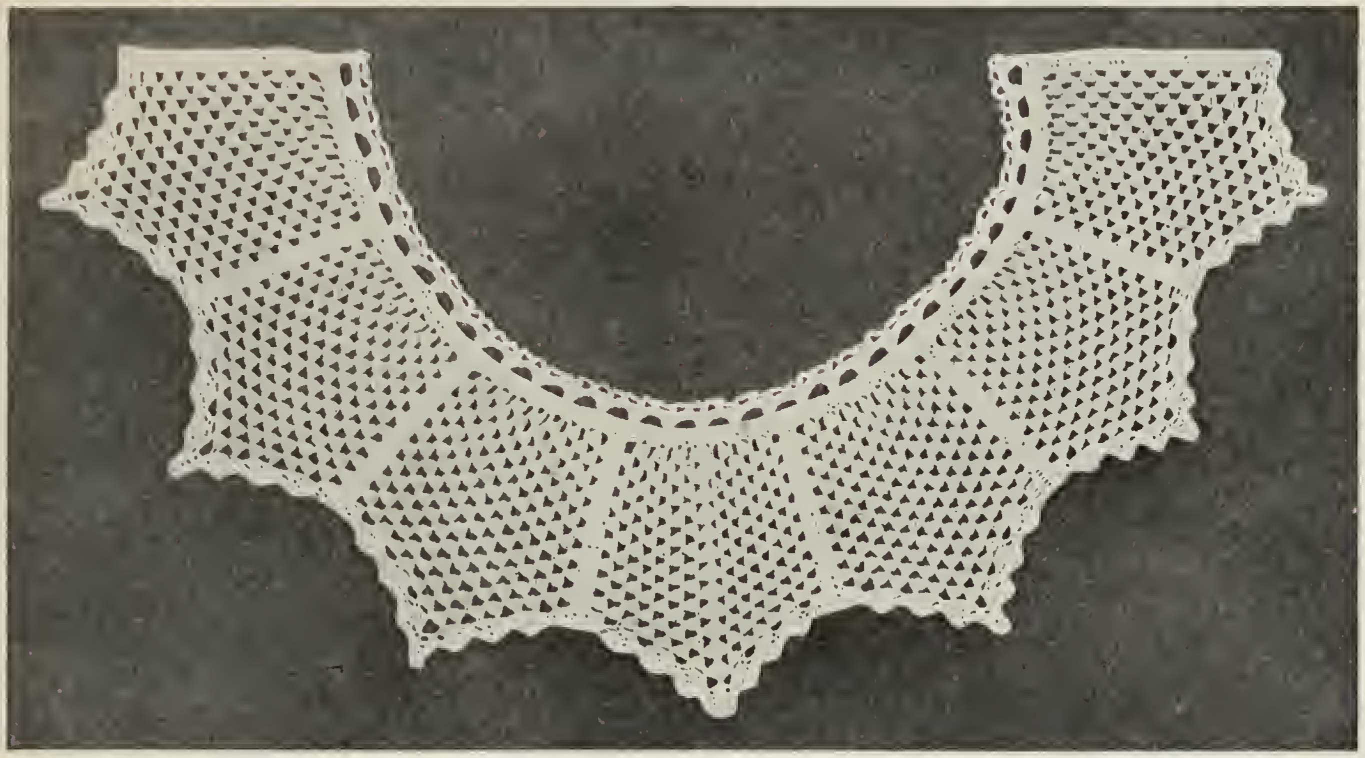
Fifth row—Ch 6, turn, skip the first 3 ch, make 1 d. c. in each of the others and 1 d. c. in the first d. c. of the preceding row. ‡ Ch 1, 3 d. c. in ch between groups, and repeat from ‡ until 9 groups have been made to the end of the row, or the top of the collar. Make 1 d. c. on the turning ch of the preceding row.

Sixth row—Work like the second row, making the groups in the ch between the groups of the preceding row, and make an extra group after the last group of the preceding row. Finish the row with 4 d. c. worked in the 4 d. c. of the preceding row.

Seventh row—Work this row like the third row. It will have 10 groups of d. c. Continue to work like the third and fourth rows until there are 8 rows of groups, always increasing. In the last row there will be 12 groups in all.

Twelfth row—Make 11 groups along the row, work 1 d. c. in the last d. c. of last group of preceding row, 2 d. c. in space next to it, and 1 d. c. in the next d. c.

Thirteenth row—Turn, ch 3, 4 d. c. on 4 d. c., then 10 shells along the row. Repeat these 2 rows, always decreasing at the bottom of the row which finishes at the pointed edge, until 15 group rows are made, with 8 groups in the last row, besides the 4 d. c. with which the row is ended. The last group row must be the same as the first group row. Make 3 rows of s. c., each with 37 stitches, then repeat from the beginning of the first group row. Do this until all the rows have been worked 3 times, and the first 11 rows worked a fourth time. Fasten off when this has been done. Now make a second piece of work exactly like the piece just finished and when it is finished overhand together the top edge of the last row of each side. When doing this be sure that the pointed edge of each piece is toward the right.



CROCHETED DUTCH COLLAR.

When the two pieces are joined make 1 row of single-crochet stitches across the neck of the collar, skipping a stitch every once in a while, enough to make the neck of the collar the right size. When that row is finished make 2 rows more across the neck, putting 1 s. c. in each stitch of the preceding row. When they are finished work all around the collar with s. c., putting 1 s. c. in each stitch except at the corners and the points, where 3 s. c. must be put in each stitch.

Now work 3 rows more around the neck, in this way:

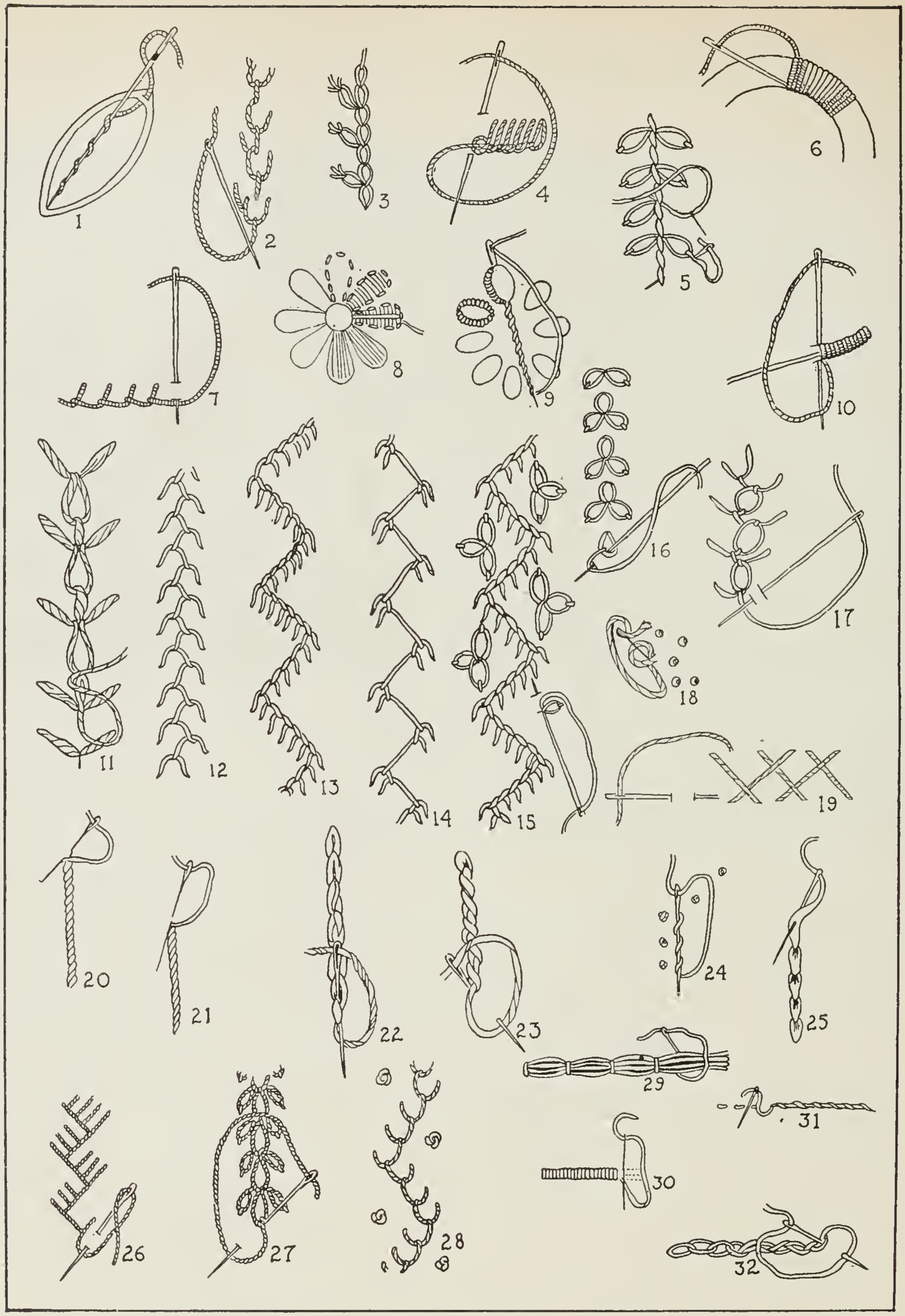
First row—Make a group of 3 d. c. in every fifth stitch, and between the groups work 3 ch.

Second row—Put 3 s. c. in each space between groups, 1 s. c. in each d. c. of groups.

Third row—Turn, ♯ ch 5, 1 s. c. in third stitch of preceding row, and repeat from ♯ all along the end. At the end fasten off the thread.

EMBROIDERY STITCHES

The many kinds of embroidery stitches shown in the accompanying picture will furnish valuable suggestions for little needlewomen. The diagrams need little explanation; thus, in No. 1 the silk is loosely wound round the needle before putting the needle-point in the fabric. This forms a heavy ridge that may be effectively introduced into a flower or leaf. No. 2 is only a loosely-made feather stitch. In No. 3 the worker must first make a line of stitches similar to those shown in No. 16 or 27. The three single stitches on the edge are made afterward. No. 4 shows a loose stitch often seen worked in wool on the edges of blankets. No. 5 is a delightful combination of daisy petals and outline stitch; the outline stitch being made first. No. 6 shows the right way of rounding a curve—by crowding the stitches a little on the inner side. No. 7 is a very open stitch, useful in fastening down an edge inclined to ravel. No. 8 shows a shadow stitch, useful on very thin material. This is worked on the wrong side of the material, and the shadowy outline, seen on the right side, is very dainty. No. 9 shows a heavy edge that is used effectively in "eyelet" work. No. 10 illustrates a heavy stem, for a thin cord is held over the outline of a stem, and fastened in place by small, closely-set stitches. No. 11 shows the ox-horn stitch; in



HOW EMBROIDERY STITCHES ARE MADE.

1, Twisted stitch; 2, Feather stitch; 3, Wedgwood stitch; 4, Scroll or stem stitch; 5, Daisy petals with outline center; 6, Rounding a curve; 7, Blanket stitch; 8, Raised shadow stitch; 9, Bullion stitch; 10, Raised stem stitch; 11, Buffalo or ox-horn stitch; 12, 13, 14, and 15, Feather stitches; 16, Clover-leaf chain stitch; 17, Brier stitch; 18, French knot; 19, Cat stitch; 20, Thick outline stitch; 21, Outline stitch; 22, Chain stitch; 23, Twisted chain stitch; 24, French knot; 25, Split outline stitch; 26, 27, and 28, Feather stitches; 29, Couching stitch; 30, Narrow satin stitch; 31, Twisted outline stitch; 32, Double chain stitch.

this the middle loop is first made, then the branching side-loops. Nos. 12, 13, 14, and 15, as well as 26, 27, and 28, are all pretty variations of the ever popular feather stitch. In No. 15 the little clover-leaf addition is made after the main outline is completed. No. 17 is a pretty combination of an open chain stitch and ox-horn. Nos. 18 and 24 show French knots; these are formed by twisting the silk or thread two or more times around the needle and then putting the needle into the same point from which the thread issued. These knots may be effectively introduced in many pieces of embroidery. A double row of chain stitches with French knots dotted between them make a dainty trimming. No. 19 is the familiar cat stitch, used principally on flannel; this is worked from left to right, so in order to see how it is made, turn the diagram upside down. Nos. 20 and 21 are outline stitches, useful in embroidering stems. Nos. 22 and 23 show the familiar chain stitch and a pleasant variation of it, while No. 25 shows a split outline stitch, useful in working in wool. No. 29 is a popular and effective stitch, for "couching" is quickly made and on a large outline the effect is striking. No. 30 shows a fine, narrow stitch that is useful in marking table linen. No. 31 shows a twisted outline stitch, in which a straight, everyday sewing stitch is first made and then half-covered by a slanting little stitch. No. 32, the last of all, should really have stood at the head, for it is the simplest and one of the prettiest stitches made, and the one that should be learned first by any little girl who wishes to become skilful in the lovely art of embroidery—one of the most interesting of the household arts.

RAFFIA WORK FOR YOUNG PEOPLE

BY ELIZABETH MACKENZIE

Basket-making should be especially interesting to our boys and girls, because it was our own American Indians who first raised the work of making baskets into an art. While the men were engaged in hunting, fishing, or war, the women were home busy with domestic duties and making blankets and baskets. It was in the patterns and designs of these baskets that the women told of Indian life; the hunt, the war, even the love story—all were woven in a basket; and while we would write a story or a record on paper, they would tell it by the figures and colors used in the basket.

So beautifully and wonderfully and compactly were these baskets woven that in some of them water could be carried; and so elaborate were they that sometimes an Indian squaw would spend her whole life in fashioning a single basket. To weave the baskets they used long swamp-grasses, reeds and roots, and they often walked miles to get the right kind of material. Instead of grasses and roots, we use raffia and reed and sometimes twine.

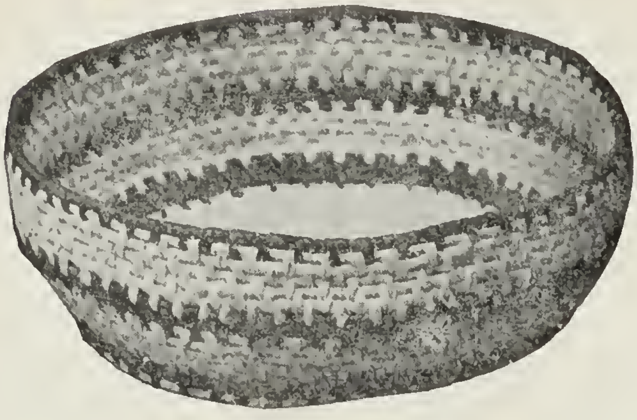
Raffia is the outer skin of a long-leaved palm growing in Madagascar. In its natural state it is very tough and creamy in color. It costs about twenty-five cents a pound in its natural color and a little more when dyed red, brown, green or blue. You can buy raffia in seed-stores and in many department-stores. Raffia work is so easy to learn that every boy and girl can make pretty and useful baskets.

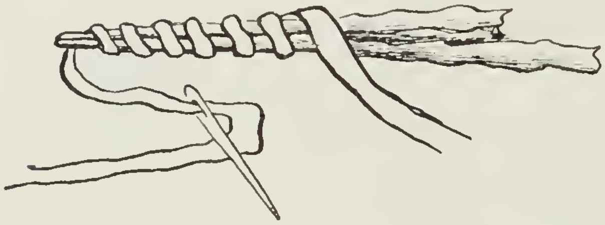
There is great delight in watching a basket grow in size and beauty. All of those shown in the pictures were made in "Lazy Squaw" stitch. This is the easiest stitch to learn as well as the quickest to use. When an Indian squaw wished to hurry with her work, she always used this stitch, much to the disgust of the more industrious of the tribe. They considered her very lazy and named the stitch after her.

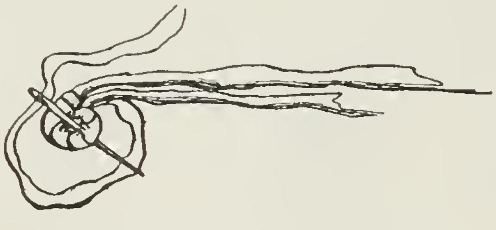
For the work of making baskets, we will need raffia, natural and colored, reed and twine; also needles both blunt and sharp, numbers 18 and 20. Work on all baskets begins in the middle of the bottom. If reed is used it will first have to be soaked to make it pliable. Soak it at least ten minutes in hot water and longer in cold water. Twine is really better as a foundation. It does not have to be soaked before using, and being softer, it is easier to work with. It also makes a softer basket when finished.

A SEWING-BASKET IN TWO COLORS

It will be easier to start a basket on a few strands of raffia instead of twine, which must be used later. Thread a sharp-pointed needle with a single piece of raffia, putting through the eye of the needle the end which seems harder. Take in your left hand the few pieces of raffia which are to form the foundation of the basket and wind the single piece of raffia (threaded on the needle) around these pieces, until an inch or more has been covered; then coil this covered raffia as tight and small as possible to make the little center; sew through this center with raffia-threaded needle and keep on winding and sewing through, until the center is about an inch in diameter. Then work the twine in for the foundation instead of the strands of raffia. Put in the end of twine with the several strands of raffia and wind both the twine and the ends of raffia as before. Always carry the ends of the raffia along with the twine for some distance before cutting them off.


SEWING-BASKET.
(Seven inches across.)


STRANDS OF RAFFIA WOUND WITH RAFFIA.
BEFORE COILING.


BEGINNING A ROUND BASKET.

After the twine has been put in place it will not be necessary to sew through the twine as in the beginning when raffia formed the foundation. Instead, wind raffia several times around the twine and, with a blunt needle, bind *to* the last row and not *through* it. Wind several times and then bind again. As raffia varies in width, no exact number of stitches can be given, but it is usual to wind twice and then bind. The stitches must be kept close together and the raffia kept as flat and untwisted as possible, in order that the basket may be firm and well made.

When the bottom has been made large enough, start the sides of the basket by placing the next row of twine *above* the last row, instead of at the edge, as in making the bottom. When we have used two rows of natural raffia, we may use red raffia for three rows, then the natural for five rows, red for two rows, five more rows of natural, and finish the top of the basket with one row of red. Be careful in finishing the basket and cover the end of the twine or reed very neatly. The basket may be made any shape by placing the twine nearer or farther from the center.

Another thing to remember is, in starting a new thread of raffia, to carry what remains of the old thread along with the twine for some distance, and wind and bind the twine and raffia together. If this is not done the ends of the raffia will not be fastened, and the basket will fall apart. Soaking the finished basket in water for a half hour will improve its appearance. The soaking seems to stiffen the basket just enough to make it firm in texture.

FINGER-BOWL COVERED WITH RAFFIA, FOR HOLDING FLOWERS

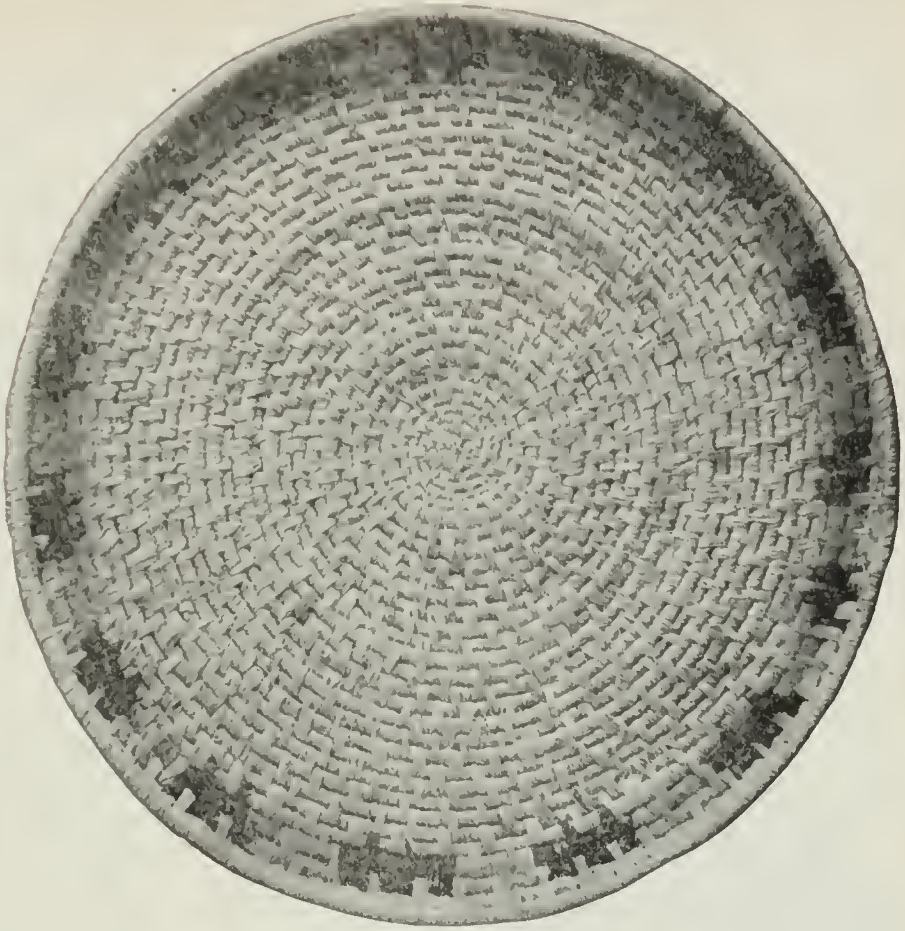
THIS little basket for holding flowers was made in the same stitch as the sewing-basket. It was fashioned to fit over a glass finger-bowl, so that it could be used for holding cut flowers. When working on a basket of this kind, have the bowl at hand so that the basket may be slipped over the bowl occasionally, to be sure it is the right

COVER FOR FINGER-BOWL.
(Five inches across.)

size and shape. After the basket is finished, soak it in water, place the glass bowl inside of the basket, and allow the basket to dry on the bowl.

A TRAY MADE OF RAFFIA

The tray is made over reed instead of twine. As in the baskets, start the center of the tray on raffia. After the little center is made on the raffia, then use the reed. Sharpen the water-soaked reed and push the end of it into the raffia which was used to start the tray. Wind and bind to the last row the same as in making the basket. The tray must be kept perfectly flat, and when it has reached the desired size, make a narrow upright edge, by placing one row of reed *above* the other. Two or three rows will be needed to form this upright edge. After you have cut off the reed, sharpen the end, and carefully finish it so that it does not show where the work stops. The simple design is made in brown raffia by taking a number of stitches in brown and then the same number in natural; then the brown, and so on. The brown is used in the last two rows of the bottom of the tray.



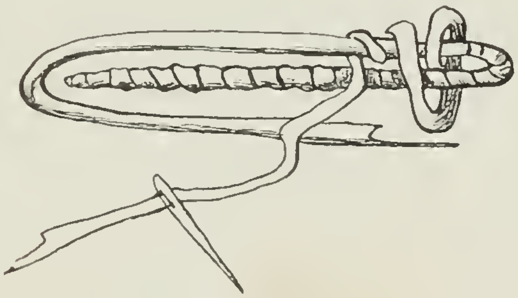
RAFFIA TRAY.
(Nine inches across.)

REED SHARPENED, READY FOR USE.

A PENCIL-BASKET MADE OF RAFFIA

This little oblong basket, which would be very useful for holding pens and pencils, is also made on reed. For a basket of this shape the work in the beginning will be a little different from the work on a round basket. Soak a reed well and then gently bend it, as shown in the picture, so that the center will be about two inches long. Cover the first row of reed with the raffia and bind the next row to it in exactly the same way as in a round basket. Keep the sides straight and firm; and when six rows from the top, start the design with a few stitches in red and about twice as many in the natural, then the red.

PENCIL-BASKET.
(Five inches across, three and one half inches deep.)



BEGINNING AN OBLONG BASKET.

In the next row make each red space a little larger and continue in this way to the top, when the entire row will be red. Finish the end of the basket as in the tray. The rings on the top of the little basket, by which it may be hung up, are made of red raffia. Take three strands of raffia and braid them together, and from this braided raffia make two small rings. With red raffia sew these rings to the top of the basket.

More durable rings may be made by winding a few strands of raffia around the finger till a compact ring is formed. This ring may be covered with a buttonhole stitch, the same as is used in making the circles for Renaissance lace.

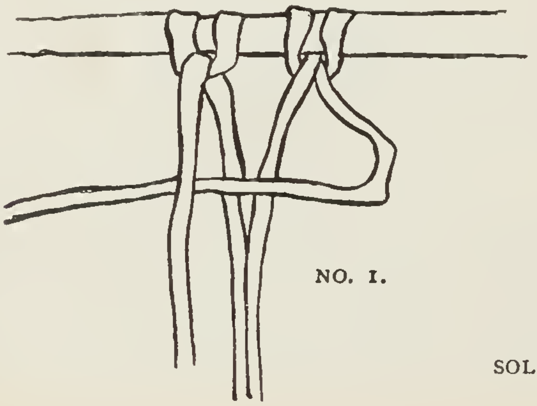
HANGING BOWL FOR FLOWERS.
(Bowl three and one half inches across.)

A HANGING BOWL FOR FLOWERS

A CHINA bowl with raffia knotted loosely over it becomes a very pretty and useful hanging basket to hold flowers. First make a flat center on reed in the Lazy Squaw stitch. This center should be large enough to cover completely the bottom of the bowl. On this center fashion, at equal distances from each other, eight or more double pieces of raffia. Attach these to the center by slip-knots. Each pair is then knotted to the next by what is called "Solomon's knot."

To make this knot, hold in the left hand one pair of raffia strands, with the single strand of the next at the right. Cross this single piece over at right angles to itself, leaving a loophole at the right-hand side. Next, take the single strand of the left-hand pair and put it over the strand which has crossed the pair, carrying it under the pair, and through the loop at right-hand side. Repeat this, and thus make a firm knot as shown in the diagram. Continue this knotting until the bowl is covered. Then gather the ends of the raffia together, and divide them so as to form two long handles. Braid the raffia and tie at the ends with an ordinary knot. This work is not done on the bowl; but, as before, have the bowl handy so as to try the raffia work on, to fit it properly and closely. After the work is finished, soak it in water, place the bowl in the knotted raffia, and gently pat the raffia into shape so that it fits the bowl. Hang it up and allow it to dry before handling.

THESE are only a few of the many forms that may be fashioned out of raffia. One may make big baskets and little baskets, baskets made on string foundations and baskets made on reed. Shape and size may be varied to suit the taste of the maker.



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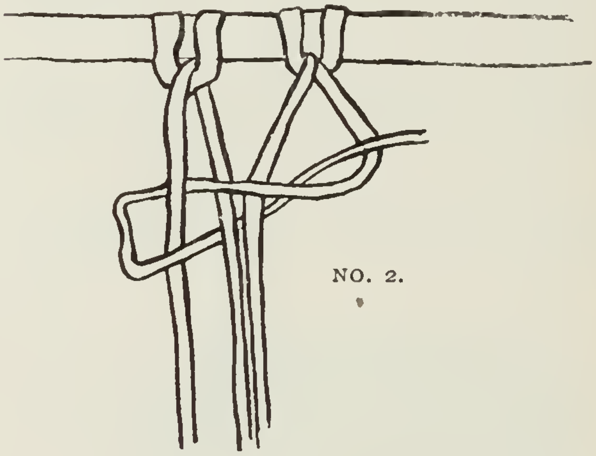

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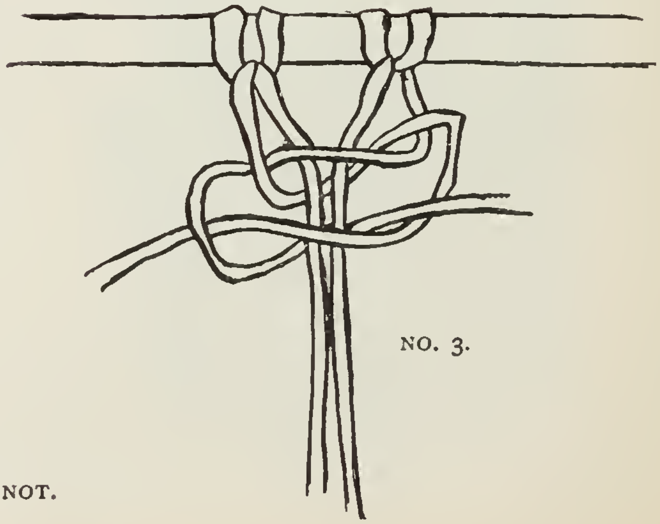


NO. 3.

SOLOMON'S KNOT.

INTERESTING QUESTIONS AND ANSWERS

WHY DOES FURNITURE CRACK OR MAKE NOISES AT NIGHT?

Perhaps we cannot be quite certain that furniture cracks so much more at night than in the daytime. For one thing, there are other noises going on in the daytime which we are more likely to be attending to; for another, it is known that when we lie awake at night in the dark, our hearing is more acute than it usually is in the daytime. Still, when all this is allowed for, it is no doubt true that furniture does make strange noises at night, and that is not difficult to understand if we remember that the air has been warmed up, more or less, during the day, and then cools down at night.

The general rule, which is true of wood as it is of most other things, is that things expand as they are heated and shrink as they are cooled. Thus furniture is liable to shrink more or less at night as it cools, and we can understand how different parts may suddenly get adjusted to each other, and so start the waves in the air which make us say that the furniture is cracking.

The question of moisture may play a part, too, because as air cools it is apt to deposit the moisture which it could hold in itself when it was hotter, and that moisture is apt to affect the state of whatever object it is deposited upon.

WHAT IS THE ORIGIN OF THE EXPRESSION "GREAT MOGUL," APPLIED TO LARGE RAILROAD ENGINES?

The Moguls were rulers of India for centuries before the English took possession of that country. Their capital was at Delhi, and the splendor with which they were surrounded was the most magnificent in the world. The Great Mogul—the greatest of all the Mogul emperors, Ackbar, was born in 1542, and he began to reign when he was only twelve years old. His real name was Jelel-ed-Deen, but he was called by his people "the very greatest," which is said in Arabic by the word Ackbar. So he became known in English as the Great Mogul.

He built the famous Pearl Mosque, and the still more famous Taj Mahal, the most beautiful tomb in the world.

The Great Mogul is said to have kept five thousand elephants, twelve thousand stable horses, and one thousand hunting leopards, so we can see how when some one wanted an expression which should mean great power, to apply to the great engines, "great Mogul" seemed to fit exactly, and when you see one pulling a long, heavy freight train over the mountains you can understand how a very expressive term was necessary to describe them.

WHAT IS THE LARGEST STATUE IN THE WORLD?

The largest statue in the world is that given by the people of France to the United States to foster the friendly feeling existing between the two nations. It is called Liberty Enlightening the World, and stands on Bedloe's Island, in New York Harbor.

The statue represents a female figure standing upright, holding a torch high above her head. The torch signifies the light cast by the rays of liberty. The statue is made of copper, one-eighth of an inch in thickness, and is kept in position by iron plates and braces. It stands on a pedestal eighty-nine feet high. The dimensions are:

From bottom of plinth to top of torch..	151.41	ft.
From heel to the top of the head......	111	"
Height of the head	13.5	"
Width of the eye.....................	28	in.
Length of nose	45	"
Length of forefinger	$7\frac{11}{12}$	ft.

The last dimension seems to us the most impressive—think of a forefinger nearly eight feet long! We get another impression of the enormity of the statue when we are told that the head will accommodate forty persons, and that the torch, which is reached by a spiral staircase, will hold twelve persons.

WHAT IS MEANT BY "MEMNON'S MUSIC?"

The statue of Memnon stands on the west bank of the Nile River, facing the rising sun, and it was said that as the sun rose each morning the statue chanted a hymn to the dawn. The music resembled the touching of the strings of a harp, and was said to be very beautiful. As it was only possible to hear it just as the first rays of the sun touched the face of the figure, travelers used to camp all night around the statue in order to hear the wonderful music.

The statue was destroyed by an earthquake in 27 B. C., and though it was restored in 104 A. D., whatever had caused the musical sounds had been destroyed, so that it no longer greeted the dawn with a song.

The music was supposed to have been caused by the rays of light striking some peculiar formation of the mouth, but just how, or what was the construction is not known. We know a little more of the conversion of light into sound, now, and it is possible that the mystery of Memnon's music may one day be made plain to us. The wonderful part of it all is that the ancients should have understood or have been able to make a statue which could remain a mystery for all of the centuries.

WHAT WAS THE FIRST FOREIGN CONQUEST BY THE UNITED STATES?

We think of Cuba and the Philippines when we speak of the foreign conquests made by the United States, but the first one was long before either of these two were thought of as ever having any connection with this country.

The town of Derne, in Tripoli, on the northern coast of Africa was captured by the United States in 1804.

There were pirates in those days, and the pirates of North Africa respected only the English flag, which they had been taught to fear. When the United States became independent, the government of Tripoli demanded a tribute, as a guarantee of protection of our ships from the pirates, and for a while it seemed best to pay this tribute, as we were not fitted to enter into another war so soon after the War of Independence. However, the tribute did not protect us, and, in 1801, the Dey of Tripoli, dissatisfied with the amount or the payment of the tribute, declared war against us. We may note in passing that this is the only time in history that war was declared against the United States—in other wars the United States has been the first to make such declaration.

For four years the war was carried on at sea, until in 1804 the American ships gathered in the Mediterranean Sea, and a vigorous attack was made on the pirates. Derne was taken by General Eaton, and the American Flag raised for the first and only time in the Old World. Tripoli sued for peace, and prisoners were exchanged, a treaty of peace was made, and Derne was given up; the payment of tribute came to an end, and our ships were safe on the high seas.

WHAT IS THE ORIGIN OF THE CUSTOM OF LIFTING THE HAT WHEN PASSING A FRIEND?

This custom had its origin in the days of chivalry, when it was customary for knights never to appear in public, except in full armor. It became a custom, however, for a knight, when entering an assembly of friends, to remove his helmet, which was very heavy, and the action signified that he was among his friends, and so had no need of the protection of the helmet. "I am safe in the presence of my friends."

Many acts of courtesy can be traced to the age of chivalry, and this is one of the most expressive and beautiful. This has come to us principally in the acknowledgment of the presence of ladies, but it is a courtesy which men sometimes pay to each other, especially youth to age. A thought of its meaning will help you to remember to pay this courtesy. "I am safe in the presence of my friends."

WHAT IS THE OLDEST REPUBLIC IN THE WORLD?

We are apt to think that the form of government which we call a republic is of comparatively recent origin, but one of the oldest countries of the world is a republic—older than some of the largest kingdoms.

When Charlemagne crossed the Pyrenees into Spain to aid in driving back the Saracens from that country, he gave, in 805, to a brave handful of mountaineers in return for the help given to him and his army, a Charter for the Valley of Andorra. These hardy mountaineers, instead of choosing a king, and becoming involved in the dissensions of Europe, established a republican form of government, and became farmers and sheep raisers. They maintained strict neutrality toward all of the countries around them, and so were never interfered with by any of them.

When Napoleon turned aside, and spared this ancient city, some one asked him why he did so, and he replied, "I spare it as a political curiosity," and it was a political curiosity indeed in those days of war and turmoil.

It is said that there is gold in the mountains of Andorra, but the people refuse to allow it to be worked, as they say that they would lose their independence if they engaged in its commerce. The little valley is only about six miles long, and a mile wide, and contains about 5,000 people. Many interesting things are told of the way that they live. Carlyle has said, "Happy that people whose annals are vacant," and this may apply to these simple mountain folk who have maintained their independence for nearly a thousand years.

WHY IS THE BRITISH SOLDIER CALLED "TOMMY ATKINS"?

"TOMMY ATKINS" has been made so famous by Kipling that this question becomes very interesting.

In the forms for information sent out by the English War Office to be put into the hands of the soldiers, the name Tommy Atkins was used to indicate the name of the soldier—that his name was to be written in that space in the final records. In this way Tommy Atkins may be said to be "first cousin to John Doe," the name which is used in legal documents in the same way.

The Barrack Room Ballads have made "Tommy" so well known to us that we all feel that we know him.

WHAT IS THE ORIGIN OF THE EXPRESSION, "HE IS A BRICK"?

THIS expression is said to have been used by the King of Sparta. Plutarch, in his life of Lycurgus, tells us that Lycurgus was asked if they should inclose the city in walls, answered, "The city is well fortified which has a wall of men instead of brick."

There is another story that an ambassador from Epirus, expecting to find the capital city of Greece inclosed by massive walls, marveled much that the unwalled city should be so powerful, and at last spoke to the king. "Sire, I have visited most of your cities, and find none of them with walls for their defense. How is this?"

"Indeed," said the king, "thou could'st not have looked carefully! Come with me to-morrow, and I will show you the walls of Sparta."

The next morning he led the ambassador out upon the plains where his army was drawn up in battle array, and pointing proudly, he said: "There are the walls of Sparta, and every man is a brick!"

WHAT IS THE ORIGIN OF THE TERM YANKEE?

THE first name given by Indians to the Europeans is said to have been Wapsid Lenape, which in their language meant simply white people, but later they tried to say the word English, and the result of that effort was Yangees. This name came to be applied among the Indians of New England to all of the white people in that section, and it was adopted, with slight variation by the people; and they called themselves Yankees. This became a distinctive word applied to all of the New England people, and they became very proud of it.

WHO WAS THE ORIGINAL "MOTHER GOOSE"?

WHEN we come to think about it, this is really a very interesting question, though perhaps we had not thought that Mother Goose was a real person.

Her name was Elizabeth Foster, and she lived in Boston. She was married to Isaac Goose, and her famous songs were sung to her grandchildren, so perhaps we might well call her Grandmother Goose. The songs were published by her son-in-law, Thomas Fleet, in 1716, who certainly did a great favor for us all in giving them to the world. Mother Goose lived to be ninety-two years old, dying in 1757. We are sure that her grandchildren must have thought that she was the most wonderful grandmother that ever any child had!

WHAT IS SAID TO BE THE SUPREME PICTURE OF THE WORLD?

THE Sistine Madonna, by Raphael, is now considered the supreme picture of the world. The Transfiguration was for a long time said to be the greatest picture in the world, and in subject, perhaps, this may still hold first place. But for universal appeal the Sistine Madonna ranks first of all of the pictures that the heart of man has ever conceived, the hand of man has ever drawn.

The painting is nearly four hundred years old, and its present condition represents one of the most wonderful instances of picture restoration known. It was painted for the Black Friars in

San Sisto, a monastery in Piacenza, but was taken to Dresden in 1753, purchased from the monks of San Sisto for $45,000 by Prince Augustus of Saxony, and from that time Dresden dates her importance as an art center. But the picture had been sadly used, the top of the canvas had been folded back, to make it fit into a frame too small for it, and it had been smoked by the altar candles. In 1826, Palmarolil, the famous Roman picture restorer, by greatest care restored this wonderful painting to new life. He found the canvas so worn that the picture must soon perish, but the paint was so thick, layer upon layer, that he succeeded in removing the old canvas, and safely glued the painting upon a new canvas. He also succeeded in removing the grime and smoke without attempting to recolor the picture, and the picture was as beautiful as when first painted.

The Sistine Madonna stands in a room in the Dresden gallery in which there is no other painting. The figures in the painting are life size, the canvas is eight feet high by six and one-half feet wide, and the frame is of gray oak, heavily paneled and richly carved.

WHY IS BREAD CALLED THE STAFF OF LIFE?

Bread has long been called "the staff of life" because it was thought to be the most valuable of all foods for human beings. We have now proved that this opinion is perfectly true, and that bread is really entitled to this name. Of course, bread can be made of various cereals—all of which are kinds of grass—but the bread to which the name refers is wheaten bread. This particular grass—wheat—yields the best and the cheapest of all foods. It is *the* food of the Western world; and if the supply of it should fail we should have to live on rice, which is *the* food of the Eastern world, and which we know to be very much inferior to wheat in its power of sustaining human life.

The supply of this "staff of life" is now falling decidedly short of the need for it, and this is one of the great world-problems of the future. The time will probably come when, for sheer hunger, we shall have to stop growing other cereals to make alcohol out of, and to grow wheat instead. At the present time so many people could not live in Europe, and notably in England, without wheat from America; but the quantity of this that America can spare is decreasing every year, and may stop altogether in less than twenty years. It is possible to grow wheat on vast areas of Europe and Asia where it is not done; and it is also possible to make a wheatfield produce far more wheat, and therefore more bread, than it does now.

HOW CAN WE JUDGE DISTANCE?

Mainly we judge by experience. For instance, a square box, as seen by us, is made up of lines running at various angles. This is true when we look at it, and a picture of it simply copies the direction of these lines. If we did not know that that was what a square box looked like, we could not tell its shape. A small child, who has no experience, is quite unable to tell.

A very young child, just beginning to observe, cannot tell distance, either in a picture or in a real thing, because it has not yet learned that lines running in certain directions mean this or that shape for the thing we are looking at. People who have been blind all their lives are similarly puzzled if their sight returns to them. It was long ago pointed out by observers of the mind that after the very beginning of our lives we never get a pure sensation of vision, whatever we look at, because we are always influenced by memory and experience, and so the eye contributes something of its own to what we see. Whenever we see distance in a picture or a real scene, the eye has made its contribution in this way.

IF ALL THINGS BORN WERE TO LIVE, COULD OUR WORLD SUSTAIN THEM?

The answer is certainly "No." The average number of fishes in the sea is generally the same, yet one female fish may produce a million eggs—of which only one or two will live. A single microbe, if there were food enough, would multiply into millions in a few hours. Rabbits introduced into a country like Australia, where there happens to be a lot of food for them, become a pest in a few years. Every kind of plant and animal, high or low, tends to multiply far too rapidly. And when we look closely at the facts we find that the very reason why practically everything that is born does not live is simply that the earth cannot sustain them all. The struggle for life that goes on without ceasing among all creatures is a struggle for the food supply; and there is always a much smaller food supply than is needed for the quantity of young life that is always competing for it.

We may wonder that Nature should bring so many more mouths into the world than she is able to feed. I think we are beginning to see that there are good reasons for this terrible waste, as it seems to be; but, at any rate, among human beings a much larger proportion of young creatures find room and food on the earth than among any other kind of living beings.

WHAT MAKES THE SOUND IN THE ORGAN?

When the organist puts his finger on a key, he allows air to enter the pipe of the organ that corresponds to the key he touches. The air is thrown into vibration in the pipe, and this spreads in all directions through the air and makes the sound we hear. It is really a vibrating column of air that produces the sound, while in the piano, or in the violin, it is a vibrating string.

So the organ is really a huge wind instrument, as the others are stringed instruments. The rate at which the column of air vibrates decides the note we hear, and depends on the length of the column, which, of course, depends on the length of the pipe. Thus, a pipe 32 feet long will hold a column of air that vibrates just half as fast as the column in a pipe 16 feet long, and the note of the longer pipe will be exactly an octave below the other. It would not do if there were nothing but a plain pipe, because, of course, the air would simply rush through it with a hiss. At one end of the pipe there must be something to throw it into vibration, a "tongue," which may be made of various materials and shapes according to the particular *quality* of the note we want. But the *pitch* of the note is decided by the length of the pipe.

ARE THE STARS REALLY CLOSE TOGETHER?

The stars are so far away that our eyes do not help to tell us their distances. Sometimes we may see a star quite close to the moon, seeming side by side, yet they may be millions of miles away. There are seven stars which seem so close, they are sometimes called the "Seven Sisters"; astronomers call them the Pleiades. The Pleiades are really what they look like—a star cluster. Of course, when we say "close together" about stars, we mean one kind of closeness, and when we say "close together" in the atoms of a drop of water, we mean another kind of closeness

The "Seven Sisters" are doubtless thousands of millions of times farther away from each other than the earth is from the sun, but, as compared with other stars, they are close together. Even on the brightest night many of us are only able to see six of the stars in this cluster, and there is an old Greek story about the seventh being lost—the lost Pleiad. But with the telescope, or, still better, with a telescope that has a photographic plate in it, we discover that the six or seven stars that we can see are really only the brightest stars of a great group which is actually to be numbered by tens of thousands. There is nothing in the whole heavens quite so wonderful as this mighty cluster of stars or suns. In all ages men have wondered at their beauty. Job, for instance, did so, thousands of years ago; look at the 9th and 38th chapters of Job.

WHAT IS GUNPOWDER MADE OF?

Modern gunpowders are very different in many ways from the old gunpowder that was used for so many years without any change. Nowadays we make smokeless powders and all sorts of "high explosives," as they are called, which are very different in composition from ordinary gunpowder. But in all cases the principle is the same. It would not do to admit air to the powder, because we should require a channel for the air, and the explosion would occur through that channel. Also, air is only one-fifth oxygen, and the nitrogen would be of no use. We must have our oxygen *in* the powder. That is done by using such a thing as saltpeter or niter which has a great deal of oxygen in it. Just as chalk has oxygen in it, so has niter, and it has the advantage that it very readily gives off its oxygen to anything that will take it.

Also when niter is decomposed the nitrogen in it gets free, and this nitrogen, besides requiring room for itself in any case, is made very hot by the burning that has occurred, and so requires much more room than it would if it were cool. Next, we must have something to burn, and that is supplied by charcoal, which is carbon, and by sulphur or "brimstone." These take the oxygen from the niter very quickly, especially as the oxygen given off from one of its compounds is specially active in combining with other things.

Thus the gases which cause the explosion when they expand are carbonic acid, sulphur dioxide, and nitrogen, together with small quantities of other gases, while the potassium, of the niter is left, combined with other things, and forms what must be cleaned out often if the gun is to work well. The invention of this mixture—carbon, sulphur, and niter, called gunpowder—was a great event in the history of war, which it completely changed.

INDIAN LIFE AND INDIAN STORIES

LITTLE LUCY BULL-BEAR.

A LITTLE INDIAN SCHOOL

BY T. R. PORTER

Out on the bleak prairie of South Dakota, in the valley of a little stream known as Wounded Knee Creek, there is a frame school-house where all the pupils are Indians. In the old days, before they were confined on great bodies of land called reservations, the Indians used to hunt all over the great western country; and while none of them could read and write, yet even the small boys could follow a trail across the prairie many days after it was made, and they could tell, from looking at the pony-tracks, whether the rider was a white man or an Indian.

But after the last Indian war had been settled—after the braves had buried the hatchet and the "peace papers" had been signed by all the great Indian chiefs—the government built school-houses in many portions of the reservations, and white teachers were sent to teach the Indians how to read and to write and to become good citizens.

And the pupils are not all boys and girls, either, but there are some men and women in every school. In this particular school in the Wounded Knee Valley there is one boy about fifteen years old; the boy's father, who is forty-five years old; and the boy's grandfather, an old man seventy years old, all going to school in the same room and all studying the same books and the same lessons; and the boy learns more easily and rapidly than his father or grandfather does.

When the little Indian boys and girls first come to school, they wear the picturesque clothes which the Indians wear in their half-savage state. But as soon as they are enrolled the government supplies them with clothing like that the white people wear. Here is a picture of little Lucy Bull-bear, just as she came to school the first day; but the next day little Lucy was dressed in a common calico dress, and her pretty Indian clothes were laid away. Lucy's father was a great warrior when he was a young man, and he was a great chief when he grew older; but he wants his little girl to learn to read and to write, to sew and to cook, and to keep house as white girls do.

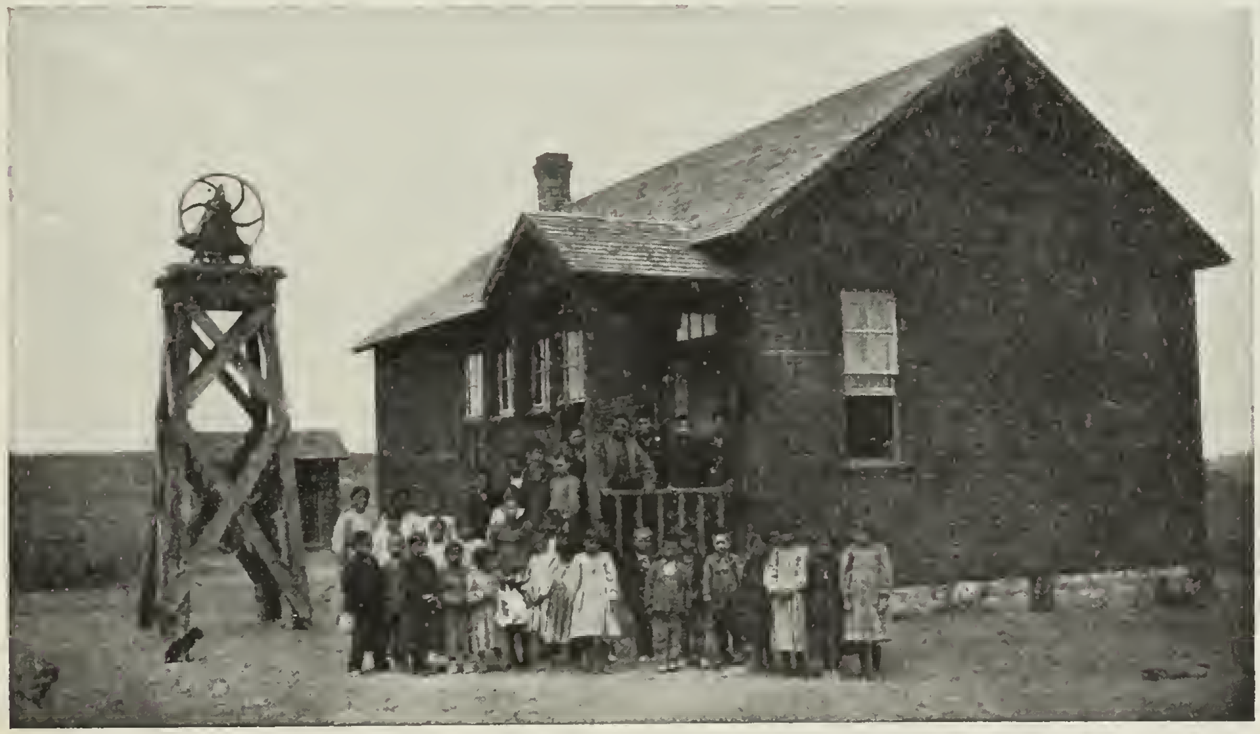
Over at a school in Montana, a little Indian girl one day came to school wearing a purple velvet dress covered with two thousand elk teeth. The dress was made just like a meal-sack, with armholes and a hole for the head; but the elk teeth are worth two and a half dollars each, so that this little girl's dress could have been sold for five thousand dollars.

The little Indians, when they first come to school, do not know how to do anything at all. They cannot even talk English, and first they have to learn a new language before they can learn to read. Yet they do this very quickly, and in a few weeks they can talk English quite well; but it takes a long time for them to learn to read. And all the time that they are learning to read and write, they are also learning to do the things which any little American boy or girl does naturally. The girls are taught to sew and to cook and to sweep; while the boys learn to cut wood, to farm, and to take care of horses, pigs, and cows. The larger girls cook lunch for the little girls and the boys, and all the schools are provided with kitchens and dining-rooms. There is also a little farm attached to each school, and in it the boys grow all the vegetables eaten in the school.

When recess time comes, the little Indians get out and play just as the white children do. They have bows and arrows, and balls and bats, and everything of that kind, and they make just as much noise as the girls and boys at any American school make.

White people used to think the Indians never smiled and never laughed; but that was because the Indians were shy and backward when white people were around. When the Indians get out by themselves, they laugh and joke and have great fun.

Every year three or four of the brightest pupils at each school are taken down to the agency, where the Indian agent lives, and are there placed in the boarding-school which is equipped by the government. At this big school there are always several hundred Indian boys and girls, and the government pays all their expenses.



INDIAN SCHOOL AT WOUNDED KNEE CREEK.

INDIAN TEPEES.

Here they learn many things not taught at the day-schools. They have sewing societies for the girls, and a printing-office and a brass band for the boys. The girls make the clothes that both the girls and boys wear, and the boys, in turn, make shoes for them all. The boys work the farm, and tend the stock, and work in the harness-shop and the carpenter-shop, and learn all sorts of useful things of that kind; while the girls learn to sew and to cook and to take care of a house.

But after the little Indian is through school he is still far, far behind the average white boy or girl; for he has never had an opportunity of seeing railroad trains and street-cars, and electric lights and gas-stoves, and sewing-machines, and thousands of things with which white children are surrounded.

THE GIANT OF FLAMING MOUNTAIN

BY HOWARD ANGUS KENNEDY

We will tell you a story about a mountain on an island at the foot of great rapids. They call it Mount Royal now, and it is half covered with a big city; but when the story happened there was nobody living on the mountain, because it smoked, and people knew that where there was smoke there might be fire.

Over the river there was a great forest; and on the other side of the forest lived a tribe of the best and friendliest giants that ever grew forty feet high. There came a day, however, when a certain young giant got tired of porridge for breakfast, and scolded his mother for not giving him something nice and tasty, such as little Indian boys and girls. The mother burst into tears and declared that such things had never been done in her family, and never would. So the discontented giant strapped up his tunic and strode off through the forest to make his own wicked way in the world.

When night came he found himself on the bank of the river at the foot of the rapids.

A few wandering Indians had camped beside the river. The giant watched his chance, and presently he caught a little Indian boy picking berries at the edge of the wood, and carried him off and ate him for supper.

Then the wicked giant looked about for some warm place to sleep in, for it was only April yet, and the nights were cold. A few curls of smoke were rising lazily from the mouth of a deep pit at the top of the mountain. The giant waded across the river and climbed up till he found a cave running into the hillside. Then he said to himself, "This must be the way in to the fire that makes the smoke."

In he went, and though he stumbled a good deal in the dark, and knocked his head against the roof, and at last had to go on hands and knees, he managed to crawl along to the very end of the cave, and pushed his head out of a hole that he found there.

"Bah!" he sputtered, as he drew back in a hurry. "It 's only that smoking chimney."

Then he stretched himself out as well as he could in the cave, and went to sleep.

In the morning the giant put his head out of the window again. There was no smoke in the pit this time. Looking up, he saw the blue sky; looking down, he saw the bottom of the pit, covered with cinders, not more than a hundred feet away.

"I hope the fire 's not gone out," he muttered; "we 'll see what a little poking will do." So he scrambled backward out of the cave, broke off the tallest pine-tree he could find, went back, and began to poke the bottom of the pit.

At the second poke the tree stuck fast and then began to disappear. The giant tugged and tugged, and the tree began to come up again, but very slowly, as if some one else were pulling at the other end. Then the giant gave one great tug with all his might, and a huge head broke through the cinders, with the end of the pine-tree gripped hard between its two enormous jaws. The head was coal-black, mottled with yellow, and had two stupid, blinking eyes.

"What do you want?" mumbled the creature, as well as it could with a pine-tree in its mouth. "What do you want, digging into a fellow like that?"

"I did n't know you were there," said the giant.

That was not an answer to the question, but the monster was too stupid to notice. "Will you promise not to stick trees into me again," he said, "if I let this one go?"

"All right," said the giant; "but who are you, and what are you doing down there?"

"I am the Salamander," the monster said with its mouth free at last. "The fire 's my bed, and the fire 's my food, and hard work I have to keep it from getting away. Once it tried to escape, and a lot of it got away up this very spout, so I have to sit about here most of the time on the watch; but now the fire has got so low I ought to be poking it, and I have nothing to poke it with. Ah! Could you spare me that stick of yours for a few minutes? It 's just the thing for a poker."

"Yes, if you 'll let me have a little of the fire up here to keep me warm at night and in winter."

The Salamander shuddered. "If you only knew how low it has got!" he said. "Why, there 's hardly a pool of fire big enough to swim in. I really could n't spare a single spark."

The giant was just going to call him a greedy old monster, but did not, and only said, "Well, never mind, I 'll get on without it. And you can have the tree if you like. You 'd better hurry up and poke the fire well."

The Salamander snapped his jaws on the end of the tree, and dragged it down out of sight without so much as a "Thank you."

Through the hole that his big stick had made the giant could see nothing at first but black darkness. However, there must have been a great deal more fire down there, deep down, than the Salamander knew, and, while he was poking his little fire-pools in side caverns here and there the long imprisoned flames spied the daylight, and knew that their time had come to be up and out. The giant began to feel a throbbing underneath, and to hear strange noises, like a troop of elephants at play. Then he caught a glimmer of light, far away in the depths of the earth. The light grew brighter and brighter, and the noises rose and rose as if the elephants were going mad. At last a long swift flame darted up out of the hole, darted back to tell the rest that the coast was clear, and then——

The giant drew back in a great hurry, but before he could get his head into the cave window the fire dashed past with the noise of a whirlwind, singeing off nearly all his hair, and flew roaring up into the sky.

The flames rushed on, faster and faster, carrying up great red-hot rocks and throwing them out on the mountainside. The Salamander, hearing the noise, came waddling back to the hole and snapped savagely at the escaping flames, but they were too excited with their adventure to care a spark for his age and dignity, so they snatched him up in their fiery arms and tossed him right up into the open air. He was terribly frightened, because if he had fallen outside he would have caught his death of cold. Fortunately he fell right back into the flames, and plunging through them he crouched down in a corner of his cavern till the rebellious rascals should get tired.

That did not happen till the night was nearly gone. Then, one by one, the flames sank back into the underground abyss. The last to give up his outdoor play was the big flaring fellow who had begun the sport. After cutting a tremendous caper in the sky this flame sank down into the pit, but stopped short at the cave window, darted in, and wound himself round the neck of the terrified young giant.

Much to the giant's relief the flame did not burn him in the least. Its glowing tongue only rested flickering on his shoulder and began to whisper in his ear.

"Thanks for letting us out, fellow!" it said. "The greedy old Salamander can hardly stop up the door again, we 've made it so wide. One of our little chaps gave a lick at a giant's head as he came up, he was saying. If it was you, he had no business to do it, and I 'll see that no flame ever hurts you again. And if you 'll only help us to keep the door from getting blocked up, we 'll all be your servants."

The bargain was struck and the promise was kept. In the giant's dismal dwelling-place one or two dainty little flames stood sentry for light, and half a dozen of their bigger blue brothers did the cooking and kept out the mischievous cool breezes that now and then ventured down the crater. Whenever the giant wanted to go hunting he had only to whistle down the pit, when up trooped the flames like a pack of hounds, and flew down the mountainside to overtake any luckless man or animal that might be wandering in the neighborhood. Only they could not carry back the prey they killed; to do that the giant had to go with them, racing down the slope in a toboggan of fire, and racing up again with all his speed in the midst of the retreating flames—because they would have "gone out" altogether if they had dawdled in the open air, and he would have perished too, for by this time he was nothing but a two-legged Salamander, and could no more have lived away from the fire than a fish could live out of water.

Month after month went by, and year after year, and we should not like to say how many unwary people (not to speak of birds and beasts by the thousand) were caught by the raiding flames and devoured by their greedy master. But as the years went by the giant grew very tired of his outcast life; and at last, one Christmas Eve, he lay down on the floor of his cave and moaned aloud, "I wish I were dead!"

"Dead?" laughed a little flame in his ear. "Who ever heard of a dead Salamander?"

"I 'm no Salamander," said the giant.

"Well, you 're much the same thing, or you could n't live among us," said the flame.

"And what if I were?" the giant went on. "The Salamander that used to keep you in is old and fat, and he can't last forever."

"No," broke in a large blue flame, "but the Salamander will last as long as we do, and so will you. One day we shall go right out, so that we can't come in again"—and the blue flame quivered sadly. "But that won't be for hundreds of years yet," he added more cheerfully.

"Hundreds of years!" said the giant to himself. "What a punishment!"

That night he did not whistle for the fiery pack to come and hunt with him as usual. His regular cave companions hovered about him in a puzzled way, wondering what the matter could be. The giant lay and thought. He thought of all the innocent folk he had destroyed, and grew ashamed of himself. He thought of the good mother he had left so wickedly, and actually began to cry. The hovering flames licked up the tears as they came, but that was no matter; they were real tears, and as they flowed the giant's hard heart became softer and softer. At first he had only been sorry for himself, and had almost made up his mind to rush out and let the cool fresh air of heaven strike him dead. But now he was eager to do one kind deed before the end came, and he was miserable because he did not see how he could get a chance.

Suddenly a party of rollicking red flames dashed into the cave and asked the giant if he was ready for a hunt. There was a capital chance, they said. An Indian, who must have come from a distance or he would have known better, had pitched his tent half way up the mountain; he had got his wife and three children with him, and they could all be caught together in five minutes.

The giant groaned, and begged to be let alone.

The flames were amazed and offended. "All right," said they, "we 'll go and eat them ourselves. We 're tired of the bones and feathers you leave us, anyhow," and off they were going.

"No," cried the giant, a good idea coming into his head. "I will go, after all."

He sprang into the midst of the flames, and they bore him up on their elastic arms and slid hissing down the mountainside.

Awakened by the strange glare and noise, the Indian rushed out and saw a torrent of fire making straight for his little skin tent. He ran back to save his wife and children, but there was no time: the flames were almost upon them.

The giant leaped from his chariot of living fire, which stopped short at his word of command. The Indian and his family suddenly felt themselves gathered up in their tent, as if by a pair of monstrous arms, and carried down to the river's edge and right across to the other shore. There they were put gently down on the grass.

As soon as they could scramble out of the tent-folds they looked around to see their mighty rescuer, but nobody was to be seen. And that is not to be wondered at. The moment the giant had set the tent down, he began to shrivel up and disappear. It hurt pretty badly, shriveling, and the giant made up his mind he was going to die; but in a few seconds, when there were only three inches of him left, the shriveling stopped—the giant had become a fairy! He was not allowed to visit fairyland for many years; in fact, not till he had made up for his bad deeds by twice as many good ones; but he was a fairy all the same, and a diligent one at his work, though not so bright and cheerful as a fairy born.

As for the Salamander, ever since the giant and the flames had struck their bargain he had squatted sulking and moping in the warmest corner of his cavern. By degrees the flames grew fewer and fewer, for many of them went so far out of doors that they had not the strength to get back, and the Salamander began to feel cold shivers run down his back, though you and I would have been toasted brown in two seconds, it was still so hot.

At last he was awakened from a doze by hearing a party of flames rush in, chattering with excitement and telling their friends that the giant was dead and gone. The Salamander was delighted. Now, he thought, he would have a chance to be master again. He leapt at the flames to drive them down into their old dungeon, but he was so fat and clumsy that he tumbled over on his back and could no more get up again than a tortoise.

The sight was so ridiculous that the flames could not contain themselves. They rushed shrieking and roaring with laughter out of the cavern, and flew so far up toward the moon that they all went out before they could find their way home again. The old Salamander began to shiver and shake; the cold numbed his toes and crept under his skin; then his heart stopped beating—and that was the end of the Salamander.

THE BATTLE THAT NEVER WAS FOUGHT

BY HOWARD ANGUS KENNEDY

THE Wood Indians and the Hill Indians were at war, though, strange as it may seem, the Hill Indians did not know it.

You see, the wild Indians used to make war with a set of rules of their own. For one thing, they did n't make a declaration of war before they began. They would have reckoned that very stupid—giving notice to their enemies to get ready to beat them. No, they kept the war a secret till they were ready themselves, and then they started and traveled as quietly as they could to catch their enemies unawares; then they rushed in upon them with a yelling and a howling as if all the lunatics in the world were let loose, and killed and captured as many as they could.

That was the sort of battle the Wood Indians meant to have with the Hill Indians. The Hill Indians had not the least idea that any one was at war with them, or that they had done anything to deserve it. Neither had they. The Wood Indians were simply tired of peace, and wanted a little excitement; and the young men who had never had any fighting wanted to show that they were as brave and cunning as the old warriors of the tribe. So a council of war was held, and after a great powwow they decided that they would have the Hill Indians for their enemies, just because they had the bad taste to live in the hills instead of the woods. When the powwow was over the warriors got up, and painted their faces yellow, and began a great war-dance. They danced all day and they danced all night, and they danced all the next day too, till they were too tired to dance any more, and just dropped down on the ground. There they slept for a few hours, and in the morning they were ready to start on the war-path.

The chief—High Pine was his name, and he wore an eagle's feather in his braided hair, and a deerskin jacket heavy with beads—had been as eager as any young buck for the war, but now he was squatting on the ground thinking, and no one dared ask him why he did not get up and lead the march. At last he beckoned to his wife, the beautiful brown Hazel Twig, and she came and squatted obediently on the ground before him and waited for him to speak. Then he beckoned to his little son, whose name was Squirrel, and told him to bring a bowl of water. The little boy put the bowl of water on the grass between his father and mother, and waited to see the magic that was going to be done.

"Look into the water," said the chief to his wife. "Look long, and tell me what you see."

Hazel Twig looked long, and then she said:

"I see a crowd of men and women and children covering the water, and they are all moving one way. Ah—now they are all gone, and there is nothing at all."

"Not even a tent?" asked the chief.

"Not even a tent," said his wife, "though I think I can see the branches of trees waving about in the wind."

"Look again," said the chief.

Hazel Twig looked again, and then she said, "I see the great chief High Pine marching at the head—at the head of something——"

"At the head of three hundred warriors, of course," said the chief.

"No," said his wife timidly, for she was afraid to contradict him. "Ah, now I see what it is; it is a pony drawing a travail [a rude contrivance for dragging a load], and there is a little boy riding on the travail. It is little Squirrel there; I can see his face quite plainly."

"Look again," said her husband. "Look long, and see what the end will be. Do you not see the fighting? Do you not see High Pine with his belt fringed with the scalps of Hill Indians?"

She looked for ten minutes, fifteen minutes, half an hour—it is wonderful how long an Indian can sit still without moving—but all she could see was nothing, nothing, nothing.

The chief gave a signal, and all his warriors came and sat down in a circle around him. The women stood and looked over their heads, and the children went on with their play—all but Squirrel, who stood proudly beside his father.

"There is great magic in the bowl," said the chief.

"Ah—ah—ah!" said the warriors in chorus, meaning "Well we know it."

"The magic tells us we must all go on this expedition together. Neither old grandfathers nor babies must stay behind. We must say farewell to our woods and live forever in the hills that we are going to take from the Hill Indians. The magic also says that when High Pine leads the way he shall march alone, with his boy the Squirrel behind him on a travail. This is a way strange to the Wood Indians, but great is the magic, and greatly to be obeyed."

"Ah—ah—ah!" muttered the warriors.

Then Hazel Twig took down the chief's tent, and rolled it up and tied the bundle on the cross-pieces of the travail—the two long poles trailing wide apart on the ground behind the pony. Little Squirrel climbed up and sat on the bundled-up tent, as proud as a king on his throne. The chief turned his face to the west, with the pony's muzzle close to his shoulder, and the march began. The warriors followed at a respectful distance, and their women-folk brought up the rear, leading a long row of ponies with all the feeble old folk and the feeble young folk of the tribe on travails behind them.

Six days they marched through that blessed wood country—a blessed living country, all alive with birds and with beasts, and musical with the humming of mosquitos. The pine-trees tossed their stately boughs, the maples waved their gorgeous cloaks, and the silly poplars fluttered all their leaves in different ways at once—whatever way the wind was blowing, or whether there was any wind or not. The very sunshine danced on the grass, keeping time to the fluttering and waving of the leaves overhead. The trail went about and about like a snake, for many foaming little streams cut through the forest in deep and rocky beds, and it was not everywhere that a ford could be found easy enough for the travails to cross by. There were many sloughs in the way, too—wide sheets of water, shallow enough to walk through if the mud at the bottom was still hard with a memory of last winter's frost.

In one of those sloughs the mud was just firm enough for the chief and his boy's travail-pony to cross safely, the water coming only up to the chief's waist; and their feet broke the spell of the frost, so when the main body of warriors came up and entered the slough they sank in the mud, and the water came up to their necks, and would have come up to their mouths if they had n't backed out and gone round. They had to go all the way round the slough on the narrow edge of long reedy grass that grew between the woods and the water. A long way round it was, and some of the warriors were rather inclined to quarrel with the chief when they got to the other side and found him quietly eating the fish dinner that little Squirrel had caught and cooked for him.

It is not a pleasant thing when you are very hungry to come and sit down at a table where somebody else is just finishing, especially if there is nothing for you till some one is kind enough to go and catch something and then cook it for you. The chief pretended not to hear the grumblers, and pretty soon they stopped. For one thing, you can't grumble very much, or at any rate very loud, when you are stuffing half-cooked fish into your mouth like those greedy Indians.

They had not been traveling more than an hour or two the next morning when they suddenly came out of the woods and on to the prairie that they had to cross before they could reach the hills.

Now the prairie is the grandest place in the world to live in—for people who are used to living there. There is such a wide spread of horizon all round you, such a broad big sky arching over you, such a glorious flood of sunshine to bathe in all day long, such a racy breeze a-blowing all the time, such a "feel" of air and elbow-room and freedom. But, you see, the Wood Indians had lived all their lives in the woods, and to them the prairie was a dreary and dead and desolate place.

"What a terrible wind is blowing!" said Hazel Twig to the head man's wife, walking by her side.

"And how the sun scorches!" said the head man's wife. "I wish there were a few trees to walk under."

"And how lonely it is!" said Hazel Twig. "There 's not a bird or a beast as far as you can see."

The chief marched on and said nothing, but he thought, "I wonder if the women have brought enough dried deer-flesh to last till we get to the hills."

When they halted for the night, the Indians made their wives put up the tents. They had been quite content to lie down under the trees as long as there were any trees to lie under, but they were afraid to go to sleep on the naked plain with all those stars staring down at them and the wind hissing angrily in their ears.

All this time the Hill Indians were hunting and sleeping happily among their hills. But when the Wood Indians had got half across the plains Chief High Rock felt a great uneasiness come over him. Perhaps some friendly little breeze had come flying back from the marching army and whispered something in his ear. The chief could n't understand it at first, but he called for a bowl of water, and looked anxiously into it to see if his magic would tell him what the matter was. The water began to boil and bubble as soon as he looked at it, and kept on bubbling at such a rate that he could n't see anything.

"There 's trouble coming," said the chief to himself. "If only the water would keep smooth for a minute and let me see a picture of what it is!"

But as the water would not get smooth, of course he could n't see a picture in it, and all he could do was to call to the Hill Spirit.

The Hill Spirit flew down to the plains, and when he saw the Wood Indians marching along, and High Pine with his tomahawk and yellow war-paint at their head, he said to himself, "This must be stopped, and I think I know how to stop it." So he began by sowing some flower-seeds in their way.

The flowers sprang up like magic—for, of course, they were magic flowers—and burst into such a blaze of red bloom, just as High Pine came marching up, that little Squirrel, drowsing on his travail, awoke and thought the sun was setting, everything was so rosy red.

"Oh, father, do stop a minute!" he cried. "What a beautiful place this is!"

"What a beautiful place this is!" said Hazel Twig, when the rest of the tribe came up to where the flowers grew.

"I wish we could stop here instead of going over that dreary plain," said the head man's wife.

"Those that want to stop can stop," said the chief angrily, "but they shall be none of our tribe," and off he marched. But a few of the women got their husbands to take the chief at his word, and they put up their tents and stayed behind to live among the flowers.

When the Hill Spirit saw High Pine marching on he flew back twenty miles, and there he stopped to sow a handful of wild gooseberry-seeds. When the chief came up he thought the gooseberries looked rather nice and juicy, but he had never seen such things before and would not have touched them, only his little son called out to him to stop, and jumped off his travail and began to eat the berries; and when the rest of the tribe came up they all began to do the same.

"Ah," said Hazel Twig, "this is better than bitter water out of the sloughs!"

"I wish we could stop here," said the head man's wife again, "instead of going on over that dry prairie with nothing but dried deer-meat to eat."

"Those that like to stop can stop," said the chief; "but this tribe is going to the war, and to the war we shall go."

And all his warriors said, "Ah—ah—ah!" which meant "Yes, yes!" A few of them stayed behind all the same, and put up their tents among the gooseberries, saying that they were as brave as anybody else, but there was plenty of fighting surely to be got without dying of thirst on the way to it.

When the Hill Spirit saw that most of the Wood Indians still marched on with tomahawks in their belts and war-paint on their faces, he flew back another twenty miles, and there he sowed a handful of blueberry-seeds. The blueberries grew on such tiny bushes, and hid themselves so modestly under the leaves, that High Pine did not even see them: he was watching for the first sight of the hills. But little Squirrel was so thirsty, and so tired of dried deer-flesh, that his eyes were searching the ground all the time as he rode along, and as soon as he spied the purple berries he jumped down, without waiting for the travail to stop, and cried out, with his mouth full, "Oh, father, could n't we stay here and put up the tepees? Do we have to go on over this dreadful prairie just to fight those old Hill Indians?"

"Hush, boy," said the chief. "Don't let my warriors hear a son of mine talk about drawing back from a fight."

When the rest of the tribe came up, there was a grand feasting on the sweet ripe blueberries, and when the most hot-headed of the warriors cried out that it was time to go on to the war, there were plenty who said they might as well wait till morning, so that they could start the next day's march refreshed with a good juicy breakfast. And when the morning came they so enjoyed their breakfast that they decided to wait and rest and have dinner in the same place; and after dinner some said that they might as well stay over another night. The chief was willing enough, but his fiery young warriors would not hear of such a thing, and the head man went up to the chief and said:

"High Pine, your tomahawk is old and foolish; you can squeeze blueberry-juice on to it and it will be satisfied; but my tomahawk is thirsty for the blood of the Hill Indians. If you will not lead us on to the war, I will, and you can stay behind and be the chief of the women and the white-hearts."

The chief said never a word, but he set his face to the west and marched off toward the hills. The pony moved off slowly after him, with his head down so that he could snatch a few more mouthfuls of the juicy berries whenever he got a chance; and little Squirrel gathered a last handful and ran and climbed on to his travail. But quite half the tribe stayed behind this time; only the fiercest of the warriors went tramping on over the dry grass, trying to forget the blueberries, and keeping up their spirits with songs of war, and looking back every now and then to make quite sure their wives were following with their tents and travails.

The Hill Spirit was very much disappointed when he saw that High Pine and his warriors were still marching on to the west. "They will catch sight of the hills before they have done another day's march," said he to himself, "and then nothing can stop them. My magic is almost run out. I have only one thing left, and that 's much too good for such bloodthirsty Indians as these; but I suppose it can't be helped." So that night, while the tired warriors slept, he sowed strawberry-seeds right in front of their camp.

When little Squirrel awoke very early in the morning the air was full of the most delightful fragance. He jumped up and ran out. At first he could see nothing but the dry grass; but looking down very closely, he found that the ground was covered with little red berries; and as soon as he had tasted them he shouted for joy, because he had never tasted anything so good in all his life. The warriors came rushing out with their tomahawks to see what the matter was, and when they saw it was nothing they were going back to sleep again; but the head man's wife stooped down and tasted the new berries, and gave a handful to her husband; and then he shouted for joy just as little Squirrel had done, and began to gobble the berries as fast as ever he could, for it was n't so very long since he had been a boy himself.

In another minute all the warriors were gobbling the new berries, and High Pine ate as fast as any one. When they had all had as much as they could eat, the chief called his warriors together, and they came and squatted round him on the grass.

"Did we ever feast like this in the woods?" said he.

"Never!" said they all, licking their lips.

"Can there be anything so good as this in the hills?" said he.

"Surely not," said they all.

"Then what are we going to the hills for?" asked little Squirrel.

And not one of them could say: the strawberries had driven everything else out of their heads.

"Then why not stay here altogether, and feast every day, instead of tramping foolishly over dry grass?" said Hazel Twig.

"These are words of wisdom," said the enchanted warriors; and they did as she had said.

The river that flowed beside their camp they called the Strawberry River, and they became the Strawberry Tribe; and though they will tell you that the Blueberry Tribe and the Gooseberry Tribe and the Red-flower Tribe belong to the same family and lived all together in the woods in the very long ago, they can never remember why they came out of the woods or why they were on their way to the hills when the strawberries stopped them.

THE LUCK-MOUSE

BY HOWARD ANGUS KENNEDY

Alabec was not a very strong Indian, nor yet a very wise one, but he was a brave Indian and a kind one too. Most of the Indians in his tribe were cruel, and if they could n't get men-prisoners to be cruel to, they used to torment any animals they could catch, so that their very dogs ran away from them into the forest and became wild like wolves. One day Alabec's brother caught a little white mouse in a trap, and brought it home and kept it in a box, and poked it with a sharp stick to see it jump. At last it jumped on to the stick, and ran up the stick to his hand, and he thought it was going to bite his finger; so he caught it by the head and tail and was just going to pull it in pieces when Alabec snatched the mouse away from him.

"Give me my mouse!" said Alabec's brother.

"If you promise not to hurt it," said Alabec.

"I 'm going to pull it to pieces," said his brother. "It 's my mouse, and I 'll do anything I like."

"That 's right," said his father; "pull it to pieces."

"Yes," said his mother, "pull it to pieces and hear it squeal." Because in those days the women were just as cruel as the men.

But Alabec held the little mouse up to his face, and stroked its soft white fur with his cheek; and the mouse whispered to Alabec, "Run away quick, or they 'll pull you to pieces too!"

So Alabec ran away into the woods. His brother threw stones after him as hard as he could, but the stones flew wide. Alabec ran straight through the forest, where there was no trail; but the bushes swung back just as if the wind was blowing them open, and let him pass without a scratch.

Alabec ran, and ran, and ran, till he came right out at the other side of the forest. Then he sat down on the bank of the river and wondered what he should do next.

"I 'll tell you," said the little mouse, though Alabec had n't said a word.

"What will you tell me?" said Alabec.

"I 'll tell you what to do next," said the mouse, "and after that too, as long as you keep me safe. You 're hungry, and you want to know where you 're to get your supper. Throw me into the river!"

Alabec was a little afraid the mouse would get drowned; but he thought it must know best, it was such a clever little mouse, so he did as he was told, and threw it into the river. The mouse swam about and about, till a big fish came along and swallowed it up. Next minute, Alabec saw the fish dancing about as if it had been caught with a line, and at last it jumped right out of the river and fell down at his feet. Alabec killed the fish very quickly, and cut it open, and the little mouse came out of the fish's inside safe and sound.

"There 's your supper," said the mouse; "now make a fire and cook it."

So Alabec started rubbing two sticks together to make fire; but the sticks were not dry enough.

"Now let me try," said the mouse. And he took a hard stone in his little paws, and bit the stone with his hard little teeth till the sparks flew; and Alabec caught the sparks in a bunch of dry grass, and made fire and roasted the fish for supper.

"Now," said the mouse, "you 're tired, and you want to know how you can sleep out here all night without a blanket." Because winter was coming on, and the nights were getting cold. "Just put me in your pouch and put the pouch on your heart, and then you can lie down and sleep anywhere and be warm all the time."

So Alabec did what he was told, and lay down on the river bank and slept, as warm as if he was wrapped up in many blankets.

In the morning the mouse made Alabec throw it into the river again, and the breakfast came jumping ashore just like the supper. Then Alabec put the mouse into his pouch and started tramping away up the riverside.

"Where are you going to?" said the mouse, peeping out of the pouch.

"I 'm going to find another tribe of Indians to live with," said Alabec, "if you don't mind."

"I don't like men," said the mouse, "except you. But if you must live with other men you may. Only don't tell them about me, or they might want to pull me to pieces, like that wicked brother of yours. And you must n't ever take off your pouch or leave me behind, or you will leave your good luck behind too."

"All right," said Alabec, "I 'll remember." And off he went, tramping up the riverside.

Presently he came to a town; and outside the town sat the chief, with a lot of young men round him, all talking at once, till he was nearly deaf with the noise.

As soon as they saw a stranger coming they stopped talking; and the chief said, "Now I must talk to this stranger, and find out where he comes from and what his business is; so go away, all of you, and hunt or play, and to-morrow I 'll give you an answer." So they all went off.

Then Alabec said, "What was the riddle they were asking?"

"It was the hardest riddle I ever had to answer yet," said the chief. "They all want to marry my daughter, and no matter which I choose the others won't like it, and I 'm afraid they will kill me."

"Which of them does your daughter want you to choose?" said Alabec.

"She does n't want any of them," said the chief; "and, what 's more, she says whichever of them I choose she won't marry him. And that 's the worst part of the riddle."

"I should like to see your daughter," said Alabec.

So they marched up together into the town and came to the chief's house.

"There she is," said the chief. And there she was—a tall, beautiful Indian girl. She was not embroidering blankets with beadwork, but chipping stone arrow-heads to make them sharper; and she had the bow and quiver slung over her shoulder and a sharp stone tomahawk stuck in her belt.

"Yes," said Alabec, when he saw her, "that 's the worst part of the riddle, true enough; but perhaps I can help you to find the answer."

Then they came into the house, and Alabec sat down at the door beside the chief's daughter.

"Those are sharp arrows you have," said he, not looking at them.

"As sharp as your eyes," said she; "and they 'll be a good deal sharper before I 've done with them."

"But not so sharp as your tongue," said Alabec. Then he sat quiet, looking out of the door and not saying anything, till the chief's daughter got restless and said:

"What have you come here for?"

"To see a girl that does n't want a husband," said he.

"What girl would want a husband if he could n't do anything better than she could do it herself?" said she.

"What is it they can't do better than you?" said Alabec.

"I can beat them at running, I can beat them at hunting, I can beat them at fishing," said the chief's daughter.

"If I beat you at running and hunting and fishing," said Alabec, "will you marry me?"

"Yes," said she, "if you can; but you can't."

"We shall see about that," said Alabec.

So he spoke to the chief, and the chief took down the big war-drum, made of raw buffalo-hide and painted red and yellow, and beat it till all the young men of the tribe came running up to see what was the matter.

Then the chief sat down in the middle, and they all sat round in a ring, and the chief said:

"I will give my daughter for a wife to any man that can run and hunt and fish better than she can do it herself. So now you shall all go and try."

So they all went down to the river with their hooks and lines. Alabec took no hook and no line, but he went down to the river a little way from the rest, and sat down on the bank; and while they were all busy with their own fishing he kept throwing the little white mouse into the river; and every time it went in a big fish swallowed it and jumped out on to the shore.

When the fishing had gone on for an hour the chief hit the big drum and said it was time to stop and count the fish. Now some of the young men had caught many and some had caught few, but the chief's daughter had caught more than any of them. Only when they came to count Alabec's fish they found he had caught more than all the rest of them put together, chief's daughter and all—a whole heap, and all big ones.

The young men grumbled, because he was a stranger; and the chief's daughter was very much astonished, but she did n't grumble.

"Now we shall try the hunting," said the chief. So his daughter, and Alabec, and all the young men of the tribe, took their bows and arrows and scattered away into the woods to see what they could shoot. Now as soon as the animals heard that all the hunters were coming out in a crowd to hunt, they fled over the mountain and down into a narrow valley where the tribe had never hunted yet. And while the other young men and the chief's daughter were finding their way along the paths or pushing through the bushes, Alabec walked straight on, and the bushes opened up to let him pass; and the way he went took him right up the mountain and down on the other side. When he came to the narrow valley and looked down over the edge, he sat down and wondered what he should do.

"I 'll tell you," said the white mouse. "Put me on the tip of an arrow, and shoot me at that big bear down yonder."

So Alabec did what he was told, and shot the big bear with the arrow and the mouse; and the big bear leaped up, climbed the cliff, and fell down and died at Alabec's feet; and there was the little white mouse sitting in one of the bear's ears. And Alabec shot the white mouse down into the valley again, and kept on doing it, and every time he did it a bear came scrambling up out of the valley and lay down and died at his feet.

When the chief hit the big drum again and the noise went rumbling through the forest, the young men came marching back to the village; and some had only a few birds and squirrels slung over their shoulders, and some had got a couple of beavers, and one was dragging a young deer that had n't known the way to the narrow valley, and another was dragging an old wolf that had been too lame to go there.

Then the chief's daughter came out of the wood; and she had nothing slung over her shoulder, and she was dragging nothing behind her.

"Are you beaten at hunting?" said the chief.

"No," said she, "I 've killed too much to carry, that 's all. Bring your toboggan, and I 'll bring mine, and we 'll fetch the hunting home." So they went into the woods, and presently they came back dragging the two toboggans loaded heavy with a couple of moose on one and a couple of bears on the other.

"Now who has beaten me?" she said to the young men; and they were all silent.

"But where is the stranger?" said the chief; and he was just going to hit the drum again when they heard a great tearing noise as if a rock had broken off the mountain and come rolling through the forest. Only it was really the little white mouse dragging the whole string of big bears behind it. It was a very little mouse, but it was as strong as a river.

When Alabec got nearly to the edge of the forest he put the mouse back into his pouch and called to the young men to come and help bring home the hunting. So they went and dragged his hunting out of the wood; and the heap of Alabec's bears was bigger than the heap of all the other Indians' hunting put together—chief's daughter and all.

The young men grumbled; but they said to each other, "He does n't look as if he could run very fast; so perhaps we can beat him at that; and if not——"

But then the chief hit the big drum again, and said it was time for the running to begin. "You must all run round the outside of the village ten times," he said.

Alabec was tired, because he had gone so far to the hunting, and he wondered what he should do.

"I 'll tell you," said the little white mouse. "Put me down on the ground and stand on me."

So Alabec dropped the white mouse on the ground and stood on it; and it was such a little mouse that he could n't feel it under his feet at all—but it was so strong that it carried him as easily as you could carry a squirrel. Alabec just had to stand quite still, and he went along the ground like skating, only he stood on one foot all the time. The mouse went so fast that Alabec raced right round the village ten times before the chief's daughter had gone round nine times; and as for the other young men, the quickest of them had n't gone round eight times.

When Alabec had finished, and was n't even out of breath, he put the mouse back into his pouch and waited for the chief's daughter to finish her ninth time round; and when she came up he asked her if she was beaten enough yet.

"Yes," said she; "we can be married at once."

And so they were. Only the other young men were dreadfully angry and jealous, and made a plot to kill him. They came to the chief and said that he ought to make a great feast in honor of his daughter's marriage; and he did. And after the feast, he said, "What game shall we play?"

"Lacrosse," said Alabec. Because lacrosse was the great game of the Indians long before white men learned it and got so clever at it themselves.

So they started out for a great game of lacrosse—Alabec and his wife and ten of the young men on one side, and all the rest of the young men on the other side, because Alabec and his wife were both so quick and strong.

But before they started, Alabec's wife said to him, "Lean back your head and let me tie up your long braided hair in a knot, so that the other young men can't catch hold of it." Because in those days there were n't any rules about not catching hold. And when he tilted up his chin so that she could tie his hair, she cut the string that he had tied the pouch round his neck with, and whisked the pouch away before he looked down again; and he did n't notice what she had done. It was an ugly old brown pouch, and she did n't think him handsome enough with it on; so she took it off and threw it away into a corner.

Then they went out to play; and they played all over the common outside the village; and because Alabec had n't got his mouse he did n't play any better than the other young men, and not nearly so well as his wife. At last, when his wife was making a long run to catch a ball, all the young men gathered round Alabec and began to beat him with their lacrosse-sticks.

"Help! help!" shouted Alabec, hitting out and shouting with all his strength.

His wife heard him and came rushing back just in time, or they would have killed him. She beat them with her lacrosse-stick so hard and so quick that they flew away like feathers before the wind; only poor Alabec was all cut about the head and very sore all over his back. As soon as he could get up off the ground he put his hand to his breast and felt for his pouch.

"Where 's my pouch?" said he, in great fear.

"Oh, that little old brown pouch?" said his wife. "I took it off and threw it in a corner, because it looked so ugly."

"Never mind about looks," said Alabec; "I 'd sooner lose all the beautiful beadwork pouches that ever were beadworked. That 's why I could n't play lacrosse well, and that 's why they could beat me nearly to death, all because you did n't like my little brown pouch! Let 's go home and try to find it."

So they went home, and found the old pouch lying in a corner; and Alabec pounced on it and kissed it and tied it round his neck again.

Next day the young Indians gathered together and said to each other:

"You see how weak the stranger is, after all. We should have killed him yesterday if it had n't been for his wife. Let us get him away from her and then we can kill him."

So they made another plot; and when the evening came they went to Alabec and said:

"We are going to sit in the river all night, to see who can stand the cold longest. Come and sit in the river with us, or never boast about beating us again!"

Alabec's wife did n't want him to go; because his wounds were not healed, and the river was so cold that it was just going to freeze. But he said he would certainly go and sit in the river with the rest of them.

So, as soon as the sun set, all the young men went down to the river and went in and sat with their chins just above the water. But they had oiled their bodies all over with thick oil, because they were cheats; and they thought Alabec would certainly be frozen to death before they got too cold to sit there any longer.

When they had all been sitting in the water a long time, they asked Alabec how he liked it.

"It 's beautiful," he said; "the water 's so nice and cool and refreshing."

About midnight the frost came down and froze up the top of the river; and Alabec had to keep breaking the ice round his neck so that he should n't get frozen in. But the other young men were so numb and stiff with cold that they could hardly move their hands, and frozen in they were; and if the water had n't frozen them in, so that their heads stayed out in the air, they would have gone under and been drowned. As it was, they were dead just as soon, in spite of the oil on their bodies.

When the moon began to go down, Alabec called out to the other young men and asked them whether they were enjoying themselves too much to go home for breakfast. But they did n't say anything.

Alabec went on sitting there, quite comfortable, till the sun rose; and then he saw that all the others were frozen stiff, so he came out of the water and marched off home.

"And did n't he ever leave his white mouse behind and get into trouble again?" you might ask.

Never once till he died; and then the white mouse crept out of the pouch and ran away, and we don't know what became of him.

INTERESTING QUESTIONS AND ANSWERS

WHY DOES THE OUTSIDE OF A CUP CONTAINING ICE CREAM GET WET?

When we put ice cream in a cup, the cup becomes very cold. The air around it becomes cold, too. The reason is that the heat in the cup and in the air are pouring into the ice cream, and what they lose it gains. Now, the air has in it a good deal of water-gas, or water-vapor; but when it is cooled this water-vapor cannot remain as vapor, but turns into liquid water, which gathers on the outside of the cup. The wet on the cup is therefore dew, and it forms on the cup just as dew would form on the cup if, without any ice cream in it, you simply put it in the garden in the evening. The amount of water that air can hold gets less the cooler the air is, and so, whenever air is cooled, some of the water in it will be deposited upon the surface which is cooling the air. The heat of the air round the cup passes into the ice cream, and that, of course, is what melts it.

WHY DOES MY VOICE SEEM LOUDER WHEN I PUT MY HANDS OVER MY EARS?

We can help ourselves to answer this question if we consider the case of a sea-shell held over the ear. There is no sound made in the shell, but it picks up all the tiny sounds that are made in the room, and echoes them to the ear. Our hands held over our ears act in exactly the same way. They echo the sounds just as the shell does.

But it is true that the special case where the voice is our own is rather different from other cases. Perhaps we are rather apt to think of sound as something that always flies "forward" from the place where it is made. But, just like the light of a candle, sound flies out equally in all directions, except in so far as special causes direct the waves or echo them.

So the sound made by our voices travels round beside our ears, and is caught and echoed into them by our hands. Not only do our voices sound louder, but they also sound very strange to us. This is because we usually hear our voices partly through the air waves coming against our ears, and partly by sound waves traveling through the head to the ears from the voice-box. Anything that alters the proportion of these two seems to change the voice.

CAN WE STORE SUNLIGHT?

When light falls on the earth it is usually changed into other things. Its power is never turned into nothing, but it is very often wasted. It is a great pity that we do not try to store sunlight, so that we may use it as we need it. We shall no doubt learn to do this some day. Meanwhile, the green world around us *is* storing sunlight. If any one said to you that there is stored sunlight in coal, you would wonder what he meant, but it is true. The coal is made from the bodies of plants that lived long ago. They lived by sunlight, and turned its power into the making of their own bodies. That power is still in the coal, as we find when we burn it. The light of the fire is sunlight that has long been stored in the earth. Every one who plants a tree, then, is storing sunlight. Some day, when every one becomes sensible, we shall not waste great tracts of land, as we do now, but shall use them for storing sunlight by planting trees upon them. Just now scarcely any one cares about these things, and I do not like to think what *our* children, when they grow up, will think of us who care so little for their interests. For every tree that is cut down, one should be planted somewhere.

WHAT IS SMOKE MADE OF?

There are many different kinds of smoke. The gases that are produced when a gun is fired are not smoke, for smoke is never a gas, but a mixture of finely divided *solid* matter suspended in air. In the case of ordinary gunpowder we get least smoke when the proportions of the various things in the gunpowder are nicely balanced. If there is too much of anything in proportion to the others it will not be used up, but will be driven out as smoke; and in any case there is some smoke with ordinary gunpowder, which is by no means the best mixture that can be obtained for the purpose.

The smoke of towns is mainly made of particles of carbon, but a special objection to it is that it is oily, and so sticks to things and catches dirt. The exact composition of smoke depends, of course, on what is burned, and on how it is burned. The smoke from a wood fire is very different from that of a coal fire; and in either case the amount and the composition of the smoke largely depend on the temperature of the fire.

The hotter the fire the better and more complete will be the burning or combustion of the fuel. We have all noticed how, when a fire has just been lit, and so is not yet very hot, dense clouds of smoke arise from it; but when the fire is well going, and burns hot and clearly, it produces very little smoke. Also, much less smoke is formed from certain kinds of coal than from others, and much depends on the supply of air to the fire. All these points are very important on account of economy of fuel, the heat produced by the fire, and the injury which smoke in the air does to human beings as well as to all animals and plants that have to breathe it.

WHAT KEEPS CARS ON A LOOP-THE-LOOP?

Of course, the puzzle is that when the car is upside down there seems to be nothing to act against the force of the earth's attraction, which is always pulling on it. Now, the car does not fall, and we are certain that gravitation is always acting, and *must* pull the car straight back to the earth if nothing acts against it. Therefore, there must be some other force acting which is powerful enough to act against gravitation so as to keep the train on the rails.

Exactly the same thing is seen when we swing a pitcherful of water round on a chain, without spilling the water. What keeps the car on the rails, or the water in the pitcher? Now, we know that if the car stopped moving when it was upside down, or if the pitcher was similarly stopped, car or water would fall. Therefore the force we are looking for, that balances the force of gravitation, must be somehow *in the motion* of the car or the water.

And so it is. Anything in motion has force in it, as we know when some one bumps up against us. Now, this force acts in the line in which the thing is moving. But when a thing moves round and round, this force is still working in a straight line, so that the thing always tends to fly away from the circle in which it moves. This force has the rather hard name of *centrifugal* force, which means the force that flies away from the center of the path in which the thing moves. It is this centrifugal force, produced by its motion, that always presses the car against the rails in any part of its course, or the water against the pitcher. It is this force also that keeps the earth from falling into the sun; and if car, or water, or earth were stopped in its course, or did not go round quickly enough, each would certainly fall—to the ground in the first two cases, and to the sun in the last case, and all for the same reason. These great laws act in big and little things alike: "The law that molds a planet rounds a tear."

WHY DO HOUSES SEEM CROOKED WHEN WE LOOK ABOVE A STREET FIRE?

Light is always bent in some degree by the various things through which it passes—as when it passes through the air to our eyes from a star, or as when a stick, half in water, seems to be bent. Now, so far as light is concerned, the air is different according to its warmth. Warm air is less dense than cold air, and when light passes from one to the other, in either direction, its path is more or less bent. So when we look at the houses through the hot gases that rise from a fire, the light, as it travels from the houses to our eyes, is bent in passing from the cold air through the hot gases, and is bent a second time in passing from the hot gases through the cold air again.

Also, as the fire does not give off the same quantity of gas at every moment, the light is bent in different ways, and not only do we see the houses crooked, but they seem more or less crooked as we keep on looking at them. This bending, or breaking, of the rays of light as they pass from one thing to another, is called *refraction,* which simply means breaking, and is very important in every way. Just as you see the houses crooked when you look at them through the gases from a fire, so we see all the stars crooked when we look at them through the air. The light from the stars is bent as it passes through the air, and so we do not see stars where they really are, but always a little distance from the real place, because of the *refraction* of their light.

WHAT IS IT THAT CAUSES AN EARTHQUAKE?

THE first reason that probably accounts for all earthquakes is simply that the earth is shrinking as it gradually loses the heat from its surface. We know that the earth has a very thin crust, which is comparatively cool, and very hot inside. The crust rests upon the inside of the earth, and as the inside shrinks it is bound to leave parts of the crust unsupported, so that they are apt to sink or crack. This will happen especially where the crust of the earth is thinner and more liable to crack than in other places. It is very common in Japan, for instance, and very rare in England.

But when an earthquake happens at any part of the earth, it starts a wave of disturbance that travels right over the earth, and can be detected anywhere if we look out for it. Then, if we notice the time when the wave reached a place, and find out what the time was when it started, we can learn how quickly the earth-wave travels. But sometimes no one knows where the wave started, and then, very often, we can guess that it started under the sea; for earthquakes may start in the earth's crust where it forms the beds of great oceans as well as anywhere else. And so there may ever be earthquakes at the bottom of the sea.

WHY DO WE SHIVER WHEN WE ARE VERY COLD?

THERE are more good reasons than one why we shiver when we are cold. The machinery of it, as we may say, is that cold, *at first,* rather excites and disturbs the nervous system, just as heat usually soothes it. We notice these contrary effects of heat and cold in the case of a warm bath and a cold dip. This, of course, is not to say that shivering is at all the same thing as the feeling of activity we have after a cold dip; but in each case the cold has been what is called a stimulant. But now we have to ask whether the shivering is of any use to us, or whether it is a wholly useless and purposeless thing; beyond any doubt it is possible to show that shivering serves the purposes of the body just as hunger does, and just as even fever often does, though we think of these as things rather bad in themselves. One good reason for shivering is that it makes us aware of cold as we might not otherwise be, and so we can protect ourselves. After the first stage of its action great cold sends the brain to sleep. Shivering perhaps serves to keep the brain awake and make it aware that something must be done.

DOES SHIVERING FROM COLD HELP TO MAKE US WARM?

I THINK that a very good reason for shivering can be found. Whenever a muscle works, heat is produced; indeed, a very great part of the heat of the body is made in the muscles, which have been called "the fireplaces of the body." Shivering consists of small, quick, to-and-fro movements, sometimes almost quite regular, as when our "teeth chatter," of most or all of the muscles of the body. Now, though shivering often makes us aware that we are cold, yet it really helps to keep us warm, for all these little muscular movements are producing heat. So we may say that when a person, by keeping still, refuses to work his muscles so as to keep warm, the brain takes the matter into its own hands and does what little it can, in spite of him, by setting his muscles shivering.

WHY IS IT THAT FLAMES NEVER GO DOWN, BUT UP?

WE might think, if we had not noticed, that this question was not true, and that flames only go upward because a gas-jet, for instance, is always directed upward. But the question is quite true, even in the case of a gas-jet that is directed downward, for we find that then the flame turns upward. If we *must* have a flame going downward or sideways, then we must have a draught to blow it, just as the wind will blow the flame of a match in any direction. This can be done in certain burners by turning the hole where the gas comes in the direction we want, and by making the gas come out very fast. Also, in the case of a fire, there is a considerable draught of air up the chimney, helping to blow the flames up with it.

But even where there is no draught at all in any direction, and when we burn something without sending any gas in any particular direction through a hole, flames always go up, and never down, as the question says. And the reasons are: First, that the gases made in the flame are very hot, and, as hot gases are always much lighter than the cold gases that make up the air around them, the hot gases of the flame tend to rise; and secondly, every flame, as the hot gases go upward because they are so light, *makes a draught for itself.* As the hot gases go up, the space they leave is filled from below, and this goes steadily on, and so makes a draught.

IS THERE ANY USE IN THE WAY HOT GASES RISE?

A GAS-JET, properly used, may actually help to ventilate a room by making a draught; and every fire does the same thing, by increasing the natural draught going up the chimney. If hot gases did not rise, I do not see how we should live, nor how anything—a fire, or a gas-jet, or anything else—could go on burning for more than a second or two. The gases which are produced when anything burns are themselves burnt, once and for all; they can neither be burnt again, nor can they help to burn anything else. Their life and power, we may say, is ended for ever.

These gases consist chiefly of carbonic acid gas and water-vapor. They are both of them completely oxidized—the carbon of the one and the hydrogen of the other are combined with all the oxygen they can hold. Nor will either of them give up its oxygen for the burning of anything else. Thus, if hot gases did not rise, and so make room for fresh air—which really means fresh oxygen—nothing could burn for long; for nothing can burn in an atmosphere of carbonic acid and water-vapor, and such an atmosphere would at once surround every burning thing if hot gases did not rise.

WHY DOES OUR BREATH RISE IN THE AIR?

EXACTLY the same is true of breathing as of hot gases, as explained in the last question. If the carbonic acid and water-vapor that leave our lungs hung round the nose and mouth, we should have to breathe them in again at the next breath instead of breathing in fresh air, and so we should certainly be suffocated.

Instead of that, they obey the law of hot gases, and rise out of the way at once, so that when we breathe in again there is fresh oxygen ready for us to use. Of course, we can defeat Nature, if we are so foolish, by cooping ourselves up in close rooms, perhaps with very low ceilings, so that the gases we breathe out can scarcely get away at all from the neighborhood of our noses, and so we breathe breathed—that is, already burnt—air; and this is one reason why people get sleepy, and even faint, in badly ventilated places.

We can also defeat Nature—at any rate, to some extent—by other means. For instance, we can put the bed next a wall, which hinders the gases of breathed air from getting freely away. Beds should, if possible, be away from a wall. If not, they should be placed so that the wall is not on the side that the sleeper usually sleeps on.

And the question about the bed-clothes suggests a way in which we can interfere with our breathing—a way which children especially are rather fond of, as sometimes they feel safer in bed in the dark if their ears are covered.

IS IT GOOD TO SLEEP WITH THE BED-CLOTHES OVER THE FACE?

MOTHERS and nurses sometimes get anxious about this, for they think—and quite rightly, too—that a child, or any one else, should have its nose free when it is asleep, and not covered with the bed-clothes. But if they will watch a sleeping child, they will see that though often the child starts to go to sleep by covering its face up, yet *always,* when it is asleep or nearly asleep, the child's body will do the rest for itself, and the head will be moved until the nose gets free of the clothes, so that fresh air can get to it, and so that the breathed gases can freely rise and get out of the way. So people who look after children really need not worry if children like to start the night with the bed-clothes almost over their faces. The child's brain, so soon as the child's self is asleep and cannot interfere with it in any way, will put things right.

It may be, too, that we get to sleep more easily by having the nose and mouth rather covered at first. The way in which birds and other animals go to sleep suggests this, and we can understand it at once if we remember that carbonic acid always makes people rather sleepy, as we all notice in badly ventilated places, such as churches and halls and crowded rooms, and almost anywhere except the open air, or a room with open windows.

HOW DID THE PLANETS GET THEIR NAMES?

THE names of most of the planets are very old indeed, and they were given to them for interesting reasons worth knowing. Mercury moves very quickly, it has to, for it is so near the sun that it would be drawn in unless it moved quickly, and its name—Mercury—is after the "messenger of the gods," whom the Greeks and Romans invented and believed in. Then Venus is very beautiful and gets its name from Venus, the supposed goddess of beauty. Mars is reddish and so suggests blood, and was therefore called Mars, after the god of war. Jupiter is the biggest of the planets, and is called after Jupiter or Jove, the greatest of the gods whom people believed in long ago.

Then, to take one more instance of the way in which the planets are named, there is Uranus, now so named, like the others, after an ancient god. It was discovered by a great German, William Herschell, who lived in England, and he wanted to call it Georgium, after the King of England. Others wanted to call it Herschell, after the discoverer, which would certainly have been wiser than to name it after a king who had nothing at all to do with it; but finally it was agreed to give it an old name like the others.

As for Earth, the good mother of us all, the ancients called her *Ge*, and so now we call the study of the earth *ge*-ology; while what we call the moon they called Luna. Hence, we have the word lunatic, because in ignorant times it was thought that when a man's mind went out of order, it was through the influence of the moon.

HOW DOES SOAP TAKE THE DIRT OUT OF THINGS?

The answer to this question has been a great deal argued by chemists, and of course it is a very important thing, for cleanliness is very necessary, and enormous quantities of soap have to be used, and it is well that we should know how soap does its work, so that we can make the soap that works best.

Now, it is fat or oil that especially makes things dirty—every one knows how oil catches dust and makes a mess on one's hands and clothes. It is the oil that comes out of the skin that makes us so quickly dirty; and this applies to other things. Now, if only we can melt or get rid of the oil on things, we soon make them clean, and the real use of soap is that, somehow, it disposes of oil. It does this, we now know, in at least two ways. Most soaps have in them a great deal of something we call alkali. This alkali simply dissolves the oil that gathers on things, and so it makes them clean. But soap takes the dirt from things in another way, as we know when we use soaps that have no alkali in them at all. It has the power of breaking up oil into a number of very tiny little drops, which are easily washed away, together with all the dirt that the oil has caught and collected.

A collection of very tiny drops of oil, held in some other fluid, is called an *emulsion*. Water alone will not form an emulsion of any oil, because oil and water will not mix. That is the reason why we cannot wash well with water alone. But when water has soap dissolved or melted in it, it is able to make an emulsion of the oil on anything we are washing, and so makes it clean.

DO PEOPLE RISE FROM THE WATER THREE TIMES BEFORE THEY DROWN?

The answer to this question is "No," and the old story that drowning men rise three times is entirely erroneous.

Sometimes people who drown do not rise at all—as, for instance, sometimes when they strike their heads against something hard at the bottom. Usually they do rise, for our bodies are only very slightly heavier than water, and the movements of arms and legs, even of a person who is not a swimmer, will raise his body to the surface until he takes so much water into his stomach and lungs that his body gets heavier and can rise no more. It is entirely a matter of chance how often, if at all, a drowning person rises. During a diving competition at the Franco-British Exhibition in London, in 1908, a diver hit the water flat so that he was "winded." He simply lay at the bottom, for he was unconscious and could make no movements. If every one had waited for him to come up even once, he would have been drowned, but a swimmer dived in and brought him up, and he was soon all right. When any one is in danger of drowning we must know that it is our duty to act at once, and so we may succeed in saving a human life.

WHY DOES AMMONIA CLEAN THINGS?

Ammonia is really a gas, but, like other gases, it can be dissolved in water, and it is more *soluble*, as we say, in water than almost any other gas. The solution of ammonia gas in water is what we usually call ammonia, and it is very largely used for cleaning things. Indeed, many people add what it called, not quite correctly, "liquid ammonia" to the water of their bath, for they find that it helps to make them very clean. "Liquid ammonia" is not a correct name, because what we call that is really water containing a lot of ammonia gas dissolved in it, as we have already seen.

Ammonia cleans many things far better than even strong soft soap, but it is so powerful that we cannot use it for everything. The reason why ammonia is such a splendid cleanser is, first, that it is an alkali, and so dissolves fats and oils, as we have seen that the alkalies in ordinary soap do. But ammonia is different from all other alkalies, because it is really a gas, and the great fact about a gas is that, if it gets "half a chance," it goes everywhere. Ammonia is thus the most searching of cleansers; not a speck of oily dirt, however well hidden, can escape it.

WHERE DO SHELLS COME FROM?

The shells in the sea are the little houses that living creatures have made for themselves from their own outsides. The sea is crammed with life from the surface to the bottom, and from its edge on the shore to its center. A very large number of the living creatures in the sea make shells for themselves, partly to protect them from the fishes, that would like to eat them, and partly to protect them from the force of the water.

We call these creatures shell-fish, but the name is a very bad one. No fish makes a shell, and these creatures are not fishes at all, but far lower in the scale of life. A fish is an animal that has a backbone and a skeleton that lies inside its body. The bodies of the creatures that produce the shells of the sea are soft, and have neither a backbone nor any other bones.

These kinds of creatures existed in the sea long before the fishes were evolved at all. When they die, their bodies are gradually dissolved away, but the empty shell that was made by them remains. It is now much lighter than it was, for its inhabitant is not there to fix it to a rock or a seaweed, and so it is cast up by the waves on the shore, where we find it. Sometimes, when we dig far inland, we come across many minute sea-shells deep down in the earth. These shells prove to us that at one time, long, long ago, the sea used to cover that place. As the little creatures died, their shells dropped to the bed of the sea and were gradually covered by layer upon layer of mud, until that which was previously the sea-bed at length became dry land.

WHY DOES SMOKE ALWAYS COME FROM A FIRE?

There is no real reason why smoke should always come from a fire, and already there are many ways of making fires which produce no smoke. The time is not very far off when no one will be allowed to make fires that produce smoke. The reason why smoke comes from our ordinary fires is the same as the reason for a great many other facts that we can notice. It it, indeed, the reason which explains the making of the coal in the first place. Carbon will not burn unless it is hot enough, and it is less easily burnt than most of the other things that can burn. So a certain quantity of carbon is apt to go unburnt, though this will happen far less if we keep the fire hot enough, which is to be done by giving it a good supply of air. It we make a forced draught, and keep up a steady, quick flow of fresh air—that is to say, of fresh oxygen—to the fire, then we shall find that all the carbon is burnt up, and no smoke will be produced. Smoke is always a sign of failure and waste, even if there were nothing worse to say about its consequences

WHY DOES A DIVER NEED LEAD ON HIS BOOTS TO MAKE HIM SINK?

The diver would certainly sink without the lead on his boots. His body itself is heavier than water, and though the small quantity of air between himself and his case tends to make him float, yet the metal round his head makes him heavier still. The point about the lead on his boots is that it makes him sink in the right direction. If it were not for that he might sink head first or sideways, and might find it exceedingly difficult or impossible to right himself. The lead serves, in a way, the same purpose as a piece of lead placed at the bottom of those little toys which cannot be upset, however much they are pushed about. A closer parallel still is the case of the balloon, which is kept the right way up by having its heaviest part below.

WHY IS THE FIRE HOT?

The heat that we feel when we stand opposite a fire is of two kinds. Partly, it is the heat in the air which the fire has made warm, and which we feel against the skin. That heat has flowed into the air from the hot fire, but by far the greater part of the heat we feel opposite the fire is what is called radiant heat, a thing which is exactly of the same nature as light, only that instead of *seeing* it we *feel it hot.* So our question is: What happens in the fire that makes it produce the heat of both kinds that we feel? It will be quite plain to us that when heat is being produced something is being done, something is being made, and we know that the power has to come from somewhere. It comes from the carbon in the coal and the oxygen in the air.

They have energy and power locked up in them which are, so to speak, released when the carbon and oxygen combine to make the fire. The proper way of saying this is that the potential energy of the carbon and oxygen are changed, when they combine, into heat energy. This heat shows itself in a rapid motion, we suppose, of the matter in the fire. This communicates itself to the atoms of the air, making them hot, and it also starts the waves in the ether which we call radiant heat.

WHY ARE THERE MORE STARS IN THE SKY SOME NIGHTS THAN OTHERS?

Of course, we know very well that there are not more stars in the sky some nights than others, but that it is a question of what we see. What really happens is that the state of the atmosphere differs very much at different times, quite apart from the presence of actual clouds. Even when there are no clouds anywhere, and all over the sky the brighter stars can be seen, the state of the air may be such—whether owing to the presence of a lot of dust high up in it, or to other causes—that the less bright stars cannot be seen. The temperature and the pressure of the air have their own effects in this respect. Much of the recent advance in astronomy has been due to the fact that great new observatories, containing the finest telescopes in the world, have been specially built on the tops of mountains, or, at any rate, as high up as possible in parts of the world specially chosen for the clearness of the air; and the higher the telescope, of course, the less the amount of even clear air that the light from the stars has to pass through before it reaches the eye of the astronomer or the lens of the camera.

DOES AIR DISSOLVE IN WATER?

Certainly air dissolves in water, and the pleasant taste and sparkle of nice drinking-water are due to the air dissolved in it. If we are in some part of the country where we are not sure about the water, and fear there may be dangerous microbes in it, perhaps we boil it in order to kill them. When we boil it, we drive out the air which was dissolved in it, and if we keep up the boiling for some time, we do this very completely. As it cools, the water dissolves a little more air in it again, but we shall still find it very flat and dull to drink. The thing to do is to pour it a long distance through the air from one vessel to another a few times, and then it will become sparkling and pleasant again. When we go on boiling the water we use for making tea or coffee, we spoil the beverage, because we drive out the air dissolved in the water. The water richest in air will, of course, be that in a shallow running stream, and that is the kind of water which was praised ages ago as the best for making tea. If air did not dissolve in water, no life of any kind could exist in water.

WHY DOES THE SUN MAKE OUR HANDS AND FACES BROWN?

The skin turns brown in order to protect the blood underneath it from the too strong rays of the sun. The brown paint, or pigment, as it is called, that is formed in the skin catches up the sun's rays and absorbs them, and so the precious blood that runs in thin-walled blood-vessels just under the skin is protected.

Sunlight is exceedingly good and necessary for us, but there is only a certain intensity of it that is good, and beyond that it becomes harmful. People vary very much in the extent to which they brown under the sun. It is said that the people who can live best in the tropics are those in whom the skin has the best power of making the brown pigment to protect the body. It may be that the deep color of dark races is protective, and that is why we find darker peoples nearer the tropics and fairer peoples nearer the poles.

WHY CANNOT WE BREATHE UNDER WATER?

As we know, there is air dissolved in water, and it is this fact that enables creatures to exist under the water. Now, a fish has a special part of its body made for the purpose of getting the air out of the water. The water is taken in by the fish, and allowed to flow along very close to thin blood-vessels in what are called the gills.

As the water flows past these blood-vessels, it gives up to them part of its oxygen, and takes from them their carbonic acid. But we have no gills, though there is absolute proof in our bodies, when they are very small, that we are descended from creatures which did have gills. Gills are only adapted for breathing in water, and the fish dies of suffocation in the air. Our lungs are only adapted for breathing air, and we die of suffocation in the water. Besides, our needs of air are much greater than those of a fish, and even if our lungs were capable of getting the air out of water that might be inhaled into them, there would not be enough to keep us alive.

WHY DO BABIES REQUIRE MORE SLEEP THAN GROWN-UP PEOPLE?

There is no doubt that babies do require more sleep than grown-up people of any kind, and the smaller the baby, the truer this is. It has been well said that "the whole duty of infancy is sleeping and feeding." Grown-up people require sleep because they require a period of rest during which their bodies can save and make up for the wear and tear of the waking time. As long as a grown-up person's body can just maintain itself, each night's sleep balancing the loss and injury of the day's work, then all is well; no more is needed. But the body of a child, and still more, of a baby, has far more to do than this. It has to make itself, whilst the body of a grown-up person is already made and merely has to maintain itself. The body of a baby or a child has to develop and grow. When it is awake, it takes its food by which it grows, but the real growing is done when it is asleep. Then the body uses the food which has been taken in the daytime, and builds it up into itself. If a child, and still more if a baby, does not get sufficient sleep, it cannot grow properly.

WILL THE EARTH EVER STOP SPINNING?

We know now, quite well, that nothing stops spinning or moving about unless something stops it. A top would not stop spinning but for the resistance of the air and the surface it spins on. The question is, then, do we know anything going on now, or anything that is likely to happen in the future, which may stop the spinning of the earth? The answer is, that the tides have this effect, though many ages may pass before it is shown; that perhaps the mere presence of the ether in space has some effect of resistance; and that in all probability the earth will, therefore, stop spinning some day or other.

WHERE DOES OUR WARMTH COME FROM?

Our warmth is all the result of the burning that goes on ceaselessly within our bodies. We do not realize how much this burning is, for we do not realize how much heat we are always losing from our bodies. If we lost no heat from our bodies, they would become as hot as boiling water in a very few hours. All this heat is made by the burning of our food. It burns, as other things burns, by combining with oxygen, and that is got into the body by our breathing. The chief part of the burning that produces our heat occurs in our muscles and in a large gland, the largest in the body, called the liver.

We may think of the muscles as the fireplaces of the body, and the fuel burnt there is mostly fat and sugar. A great deal of heat is produced when a muscle contracts, and that is why hard exercise makes us so hot; but, even when the muscles are still, this burning and making of heat are always going on. The liver, too, is always active, and we know that the blood leaving the liver is considerably hotter than the blood going to it.

Though all parts of the body do not produce equal warmth, they are all kept at just about the same temperature by the circulation of the blood—which takes heat from the hottest places, such as the liver, and gives it to the coldest places, such as the fingers and toes.

WHY CAN WE OFTEN SEE THE WHOLE CIRCLE OF THE MOON WHEN IT IS NOT SHINING?

The reason is that the earth shines brightly by the sun's light, just as the moon does; and the earth's light is enough to light up the moon, so that we can sometimes see even the part of its face that is not lit by the sun.

There is a very curious and celebrated mistake in a famous English poem, which shows that the poet did not at all understand the moon, and apparently had never seen what we have seen. It is "The Ancient Mariner," by Coleridge. He speaks of

> "The hornèd moon, with one bright star
> Within the nether tip."

Of course, no one ever saw a star within either tip of the crescent moon, because the rest of the moon is there, and would hide the star. The nearest star is, of course, many millions of miles farther away than the moon. If Coleridge had ever seen the moon as described in this question, he could not have made such an extraordinary mistake.

DO MICROBES HELP TO MAKE CREAM?

Nowadays we are usually in a hurry, and cream is therefore very often got from milk artificially by the use of what is called a *separator*. This method is more thorough, as well as quicker. But we have lately learnt that there is a good deal more than this going on in cream. The making and what is called the "ripening" of cream depends very much upon microbes—not nasty but friendly ones—which naturally live in milk. Different kinds of microbes differ in their effect on the cream, and that is largely the reason why cream varies so much as it does. In Germany places have already been established where the best kinds of microbes for this purpose are grown, and can be sent by mail to the farmer for preparing his cream.

TALES OF TRAVEL AND EXPLORATION FOR LITTLE FOLK

ALONG NEWFOUNDLAND AND LABRADOR

BY GUSTAV KOBBÉ

THE most northerly lighthouse on the coast of this continent stands on Belle Isle, at the head of the straits of that name, a little northeast of Newfoundland. By what freak of taste it was called Belle Isle I cannot say; for even the old navigators had such a horror of it that on their charts they marked it with the figure of a demon.

The morning the little mail-steamer on which I cruised "down on the Labrador," as the Newfoundlanders say, plunged and rolled past it through the surge, the rugged mass of rock crouched there as if ready to seize its prey of ships and human lives. The surf, unheard at our distance, flashed around its base like a long row of glistening teeth. A huge iceberg had drifted in and lay stranded at one end of the island; far up on the rocks was the lighthouse; on a shelf below stood a little hut with provisions for shipwrecked sailors; the gray morning mists made the sea look heavy and sodden, and altogether this glimpse of Belle Isle was the most desolate scene I had ever beheld. Over our bow the barren coast of Labrador was faintly outlined, and as the last lighthouse on the continent dropped astern, I felt that we were indeed drawing away from civilization; and this feeling was strengthened when, as we turned our prow northward, we sighted the vanguard of the seemingly endless procession of huge icebergs drifting slowly down in single file from the mysterious regions of the north.

We had met with single bergs along the Newfoundland coast, but off Labrador they became a constant and unspeakably grand feature in the seaward view. I doubt if they can be seen anywhere else except in Arctic and Antarctic waters in such numbers, variety, and grandeur. The branch of the Gulf Stream which pushes its way into the Arctic Ocean has sufficient force left when it is reflected by the frozen northern boundary of that sea to send an icy current down along the Labrador coast. Practically all the bergs that break loose from the ice-sheathed shores of Greenland are borne southward by this current. One morning, when I went up on deck, I counted no less than one hundred and thirty-five huge ones. Some of these were great solid blocks of ice; others were arched with numerous Gothic passageways; some reached with spire-like grace high up into the air; all reflected with prismatic glory the rays of the sun.

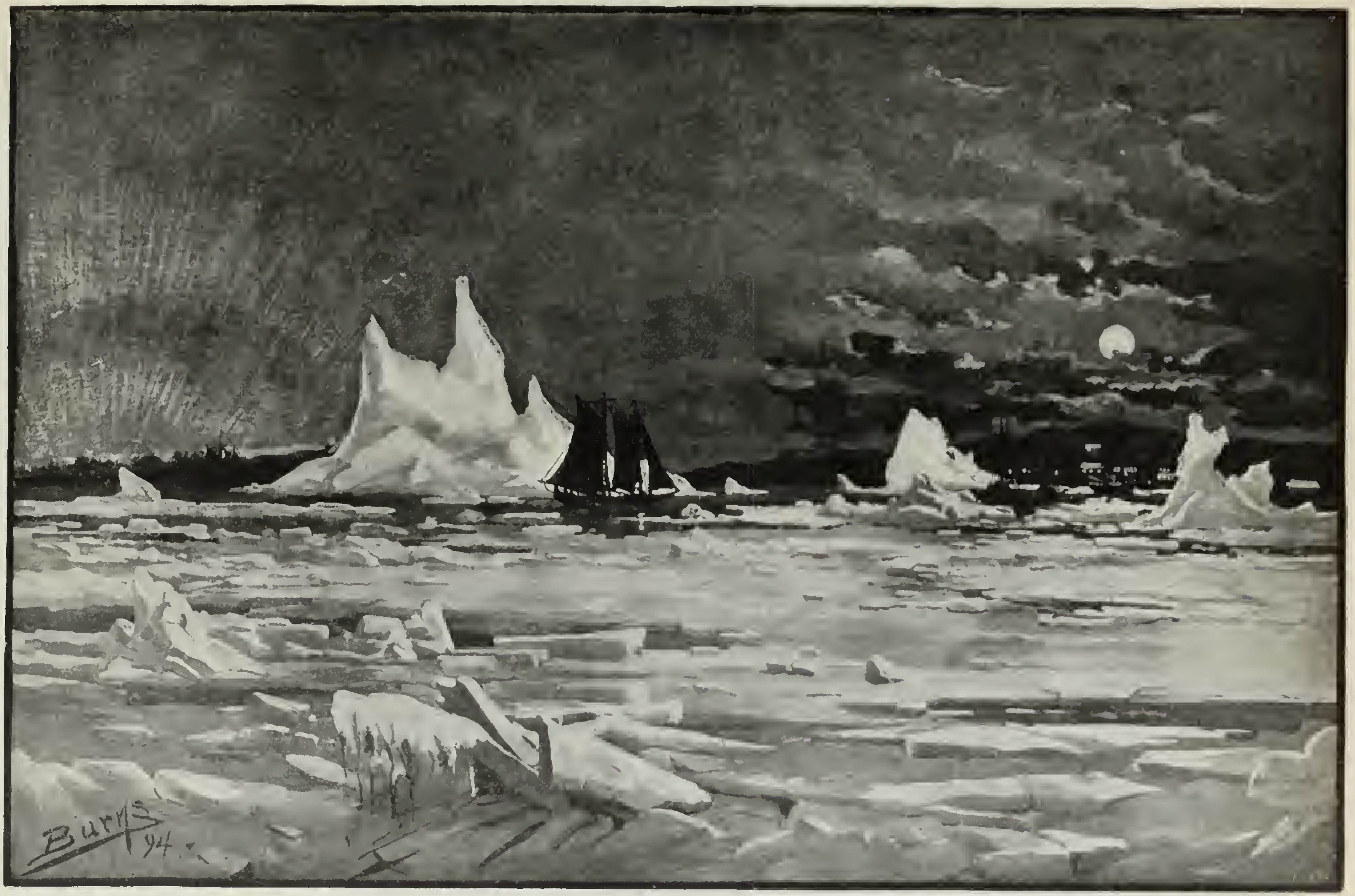
The "iron-bound" coast of Labrador is guarded

A BELFRY AT LITTLE BAY, NEWFOUNDLAND.

by groups of islands—barren, hopeless, and forlorn-looking rocks, all the more desolate in appearance for the miserable fishing-huts or "tilts" that have been thrown together on them. Entering through some narrow passage between these islands, the steamer anchors for the night in a rock-bound basin; for it is too dangerous work to navigate the Labrador waters after dark. The narrow passages between the islands, both along the Labrador and in the Newfoundland bays, are called "tickles," and aptly so, for it seems as if the sea had reached out foamy fingers and tickled the rocky ribs of the coast until it split its sides with grim, stormy laughter. One evening we found one of these tickles nearly blocked by a huge iceberg which had drifted into it and grounded. We passed near enough to feel its chilling breath, and to have thrown a biscuit on it, as the sailors say. We had hardly anchored in the harbor before we heard loud reports in rapid succession, like the firing of field artillery. Looking in the direction from which they came, we saw above the heights that surrounded the basin the peak of the iceberg swaying slowly and majestically to and fro, and finally disappearing, a peak of different shape rising up from behind the height and taking its place. They say that an avalanche is sometimes so delicately poised that the vibrations from a shout or a hand-clap will start it on its destructive course, and possibly the wash from our steamer had disturbed the iceberg's equilibrium. At night the moon rose and the Northern Lights throbbed in the sky; so that the iceberg's peak was at times bathed in silver, at times in a clear translucent crimson. It is n't often you find a combination of iceberg, moonlight, and Northern Lights; and feeling that I might never again behold such an exquisite scene, I remained for hours on deck watching it.

RED BAY. A LABRADOR OUTPOST.

I think the height of icebergs is usually overstated. When an object towers above you, it is apt to seem much higher than it really is. At first sight I thought some of the bergs we passed were four or five hundred feet high, but I doubt if the highest was over two hundred. But you can imagine what a vast mass of ice a berg is, when I remind you that only about one tenth of it is above water. It is dangerous to venture near an iceberg, because you never know when



SCENE IN LABRADOR. ICEBERGS BY MOONLIGHT AND THE NORTHERN LIGHTS.

you may strike upon its submerged portion as upon a rock. The captain of a Newfoundland steamer—he was an old Arctic navigator, too—once ran near a berg to please some passengers. The wash from the steamer disturbed the berg's equilibrium and caused it to sway. Part of it that had been under water rose to the surface under the steamer and lifted it out of the water. For a moment it seemed as if the vessel was doomed. It might have been crushed under tons of falling ice, or toppled bottom up into the sea. Fortunately there was a slope in the ice down which the steamer slid as from the launching-ways. No great damage was done, but I doubt if that captain ever again gratifies his passengers' curiosity. Of course some icebergs are mere mounds, and the fishermen have a cheerful method of securing their ice-supply by going out in their boats, catching a small berg, and towing it ashore. Not only bergs but ice-packs are often seen here in summer. The fishermen call a pack a "loom of ice"; and on my cruise I saw late in August, off Cape Harrigan, the white glare of the distant loom, which the week before had kept nearly the whole offshore fishing-fleet helplessly locked in one of the harbors.

A FISHING-VESSEL IN A LABRADOR "TICKLE."

Owing to the vanguard of rocky islands strung out along this coast, harbors are numerous—so numerous that a quaint Western man, the only passenger besides myself who ventured on the mail-boat this cruise, remarked that if harbors were only worth a cent apiece, Labrador would be one of the richest countries in the world. But, in spite of these many shelters, rocks and ice are so fatal to shipping on this coast that the mail-boat rarely returns from a trip without bringing in some shipwrecked crew. After one storm three hundred shipwrecked sailors were transferred by her at Battle Harbor to the larger vessel which plies between there and St. John's. On our trip we picked up the crew of a stanch English vessel whose captain had, in entering one of the tickles, to choose between ice and rocks, and so ran her on the latter. When we entered a harbor our

1. FISHING WITH A SPY-GLASS.
2. DRYING THE NETS.

mate always took soundings, but before we let go the anchor our captain would sing out: "Any timber, Mr. Parsons?" If the mate said, "Yes," it meant that some vessel had left its poor old ribs on the rocky bottom, and we must drift on and sound again.

Sometimes Labrador is ice-bound from September till June; but through all this long and dreary winter the lighthouse-keeper on Belle Isle must maintain his watch, to be ready to light the lamp when the break-up comes. For months he sees nothing but a frozen plain, uncertain of footing and impassable, and in the distance the ice-sheathed cliffs of Newfoundland. The few who have made their way to the interior of Labrador say it is a vast wilderness of huge boulders, varied only by morasses and lakes. An old French writer speaks of it as the "Land of Cain," and the latest explorers complained that they suffered bitterly from cold because they could not find fuel enough to maintain camp-fires. Often, indeed, they had difficulty in making even a little blaze for cooking.

Naturally, such a country has not invited settlers, and it is not surprising to learn that in its whole vast area—two and a half times as large as Great Britain and Ireland—there are not more than four thousand dwellers; of these only

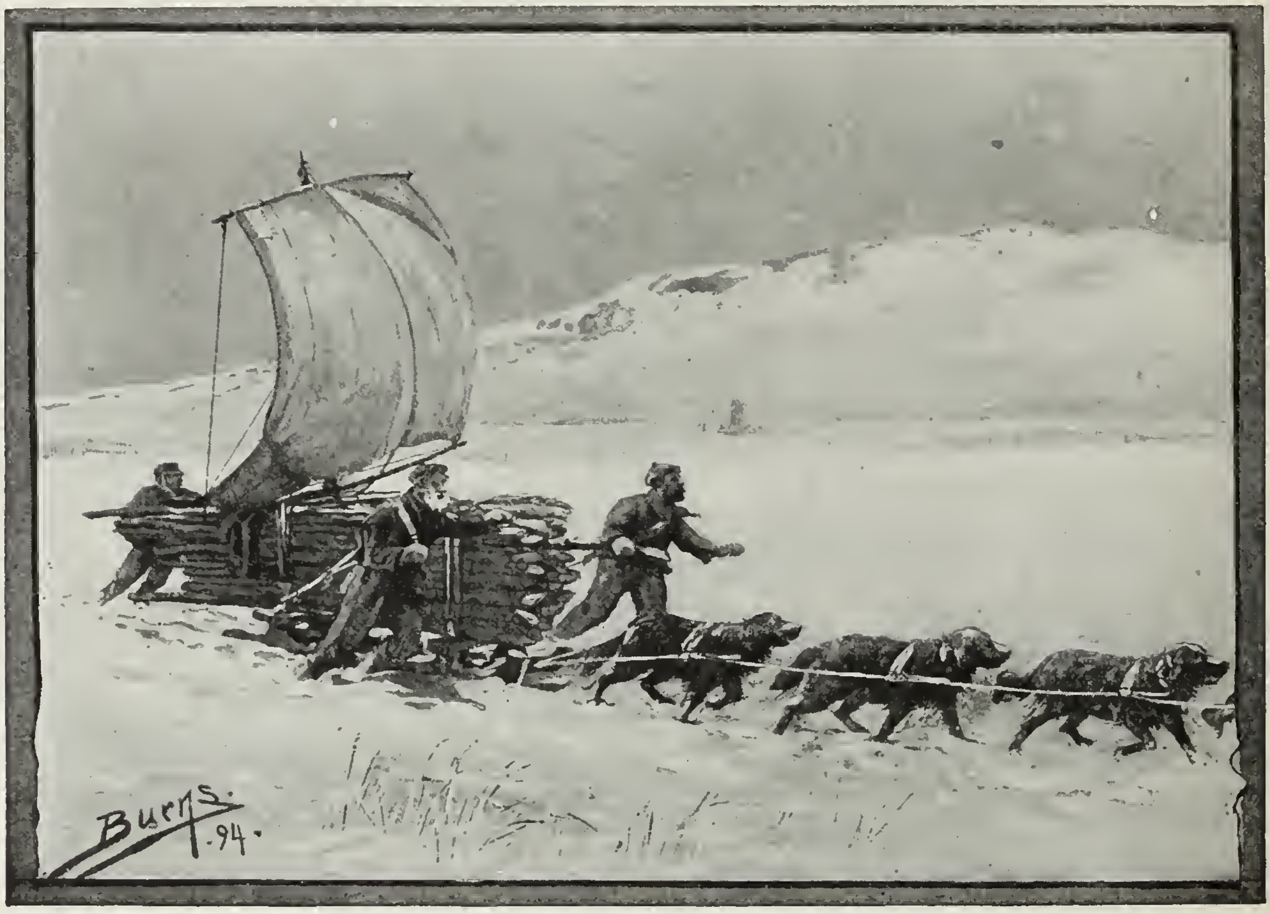
"GASHERS"—LABRADOR FISHING-BOATS.

about one half are whites, the others being Eskimos and Hudson Bay Company trappers and hunters. These are a shiftless lot who come down to the nearest Company post early in summer, and exchange their pelts for provisions, planting themselves down at the post, and proceeding to gorge themselves until their entire stock is exhausted. A pound of tea and a bag of flour is the most that one band of these "mountaineers" has been known to carry back—all they had to show, except temporarily satisfied appetites, for their whole winter's work as hunters in that desolate region.

These trappers and hunters are Indians, but are always called "mountaineers"; while the Eskimos, who have not a drop of Indian blood in them, are called Indians, though "Huskies" is the favorite term for them among the fishermen. The fishermen, mostly Newfoundlanders, skirt the Labrador coast in summer in deep-water craft, or fill up the rough fishing-stages on the rocky islands, which during the winter have been either wholly deserted, or left in charge of a storekeeper.

There must be some attraction in this wild life; for a keeper who, after living twenty years at one of these desolate outposts of civilization, went to London for a little change, returned to Labrador as soon as possible because he found London "so lonely"; and Hudson Bay Company agents who have given up their positions to go back to civilization have been glad to return to their posts. They missed the free, open-air life; but above all, probably, their autocratic sway, which makes them kings within the boundaries of the post.

A Labrador fishing-stage usually consists of a long, low frame-house, and little one-room huts, or "tilts," as they are called. The house is used as a store and dwelling for the agent of the Newfoundland merchant who has fitted up the stage. All the fishermen who occupy the tilts work for the merchant, and are paid for their fish in provisions from the store.



BRINGING IN WOOD ON A "DOG-AND-SAIL" SLED.

The tilts are like those seen in the Newfoundland fishing and mining outposts (every settlement in Newfoundland except St. John's is an outpost). The sides are logs set upright and supporting sod-covered roofs—wretched abodes at the best. Along the Straits of Belle Isle the Labrador coast is fringed with a strip of coarse grass land, and here you may see an occasional small vegetable-garden surrounded by a fish-net for a fence. At Blanc Sablon I saw a desolate little burying-ground amid the swaying rushes. Near by lay a couple of worn-out boats, bottom up, and nets spread over the ground to dry. Here, too, I saw for the first time the dapper little Labrador gasher—a small fishing-craft not much larger than a dory, but with sharp prow and stern, and two masts fitted with reddish-brown sails. These are telling bits of color when the gashers skim over the deep blue water, with the foam streaking along their quarters and glittering in their wake. Altogether it was a varied scene: the headland, from a staff on which there fluttered the flag of the merchant who owned the "outfit"; the gashers dashing in and out among the punts and jacks (stoutly built two-stickers larger than the gashers); a fishing-schooner with furled sails, but with toil-stained nets streaming from her spars in an endless variety of lights and shadows, according as the meshes twisted or bulged in the breeze; and in the distance the exquisite green-and-white spires of an iceberg. A note of toil drones through it all, however; for women are sawing and chopping wood while the men are hauling the nets. A curious implement of fishing in these waters is a spyglass with plain window-glass in place of a lens. A man in the bow of a fishing-boat thrusts the glass in the water, and, peering through it, discovers whether there are fish enough on the bottom to make it worth while to anchor; for anchoring in deep water is a toilsome matter.

'LOGIE BAY, COAST OF NEWFOUNDLAND.

In winter Labrador is simply frozen out from the rest of the world. One "komitick," or dog-sled, mail reaches some of the more southerly settlements late in the spring. The Moravian missionaries at the Eskimo villages further north endeavor at least once a winter to visit by komitick the few scattered white settlers within a hundred miles or so of the missions. Sometimes the komitick is overtaken by a severe snow-storm before shelter can be obtained. Then the missionary and his Eskimo driver dig a deep ditch down in the snow, and camp in the bottom. The gases from the camp-fire prevent the snow from floating in, and the travelers are sheltered from the icy blasts. At Battle Harbor, Labrador, where there is a church (there are only two churches, I think, on the Labrador coast south of the Moravian missions), they have a public sewing-machine, and one long winter, when the kerosene-oil supply became very low, the women gathered at the parsonage and did their sewing by the parsonage lamp. As the Battle Harbor mission is too poor to furnish the wee church with a bell, the rector signals the call to service with a flag. High among the rocks at Little Bay, Newfoundland, I saw two little churches. One of these had a small belfry perched on a still higher rock. The other's bell swung from a tall spar; and to ring it one was obliged to climb a ladder much like the shrouds of a vessel. The dog-sled is also the regular method of winter traveling over the frozen bays of Newfoundland; only it is drawn by Newfoundland dogs instead of by the half-wolfish Eskimo canines upon which the men of Labrador have to rely. The Eskimo dogs, with the equally savage mosquitos, make life ashore a burden during summer in Labrador. A stick to beat off the dogs and a veil as a protection against the mosquitos are absolutely necessary. It is a curious fact that the further north you go the more pestiferous the mosquitos become. They are worse in Labrador than in New Jersey, and are still worse in Greenland than even in Labrador.

SEALING IN LABRADOR.

"Fish" in Newfoundland and Labrador means codfish, which are to those northern countries what cotton is to the South. All other fish, except salmon, they despise, for "fish" is money. With it they buy their clothes, their flour, tea, "bread" (hard sea-biscuit), and, above all, their "long sweetness" (molasses), which are about the only edibles you will find in ninety-nine out of a hundred tilts. When a Newfoundlander speaks of Venison Tickle, or some other fishing-stage, as the "garden of Labrador," he does not mean that flowers and vegetables grow there in abundance, but that the waters of the tickle teem with "fish." In Newfoundland fishing is carried on from regularly settled villages and several of the larger outpost towns. The fishing-village best known among tourists is Quiddy Viddy, about two miles from St. John's; but Logie Bay, five miles from that city, is the more picturesque. The bay is simply a narrow split in the beetling cliffs. Lines to which the boats are moored have been hung across it, and so steep are the sides that the fish are pitchforked from platform to platform built over narrow shelves at successive heights, the huts hanging from the declivity far above the level of the sea, like cliff-swallows' nests.

Late in February the Newfoundland sealing-steamers break through the ice in St. John's harbor, and make their way to some northern outpost, lying there until March 10, the earliest date on which the law allows them to "go to the ice." They stand out to sea until they meet the immense fields of ice from the Arctic Ocean. These fields are often many square miles in extent, and fairly teem with seals. A great seal-hunter told me that the sea seemed suddenly converted into an ocean of seals and ice. The steamer breaks into the jam and floats with it or skirts along the edge, the crew, two or three hundred in number, taking to the floating ice and living there for days and nights. The young seals fatten so rapidly that sealers say you can actually see them grow while you are looking at them. The poor creatures are easily killed, a blow with the butt end of a gaff finishing them. The hunter then "sculps," or skins them, inserting a sharp knife under the fat and with marvelous dexterity taking off the "pelt"—skin and fat together—in about a minute and a half. A party of men will "pan" their pelts,—pile them up to the number of about a thousand,—and thrust a gaff with the ship's flag into the pan. When there are pans enough, the steamer breaks into the ice and hauls them aboard with a donkey-winch; or the men drag them to the vessel's side.

The Newfoundland seal-hunters always speak of seals as "swiles," and for our word "carry" they say "spell." A school-master, who had been listening to a seal-hunter's story, said sneeringly:

"Swiles! How do you spell swiles?"

"We don't spell 'em," replied the hunter; "we most generally hauls 'em!"

THE COLD, COLD NORTH

"Up! up! Let us a voyage take,
Why sit we here at ease?
Find us a vessel tight and snug,
Bound for the Northern Seas."

I ONCE read of a boy who went to the cold, cold North. You will, I am sure, like to hear his story. His father was a sailor, who had made up his mind that he would find a new and short way from Europe to India. The name of this sailor was Henry Hudson, and his son's name was John.

Henry Hudson was a poor man, but, all the same, he was very wise and clever. He knew the stars by name, and he knew as much about the sea as anybody of his day. He died, it is supposed, in the year 1611.

No ship had he of his own; but when it was known that he thought he could find this new way, a rich man found him one. The rich man knew how useful a short way to India would be.

But a ship is of no use without men. It took Henry Hudson some months to find a crew who would make the venture with him, for till then no one had been so far toward the north as he meant to go. When the crew was found, as much food as would last for six months was taken on board the ship.

At last one fine morning, when all things were ready, the ship set sail from the river Thames, in England. A great many people went to watch the ship leave. A cheer rang from them when Henry Hudson, with his little boy at his side, took his stand on the bridge of the ship, for every one wished that the brave sailor might come back in safety, having found that for which he was going. Little John felt proud of his father. He knew the cheers were for him.

For a good many days a fair wind took the ship away, and Henry Hudson at the helm kept it in its right course. At first the voyage was very pleasant. The sun shone on the waves, and the sea looked like a large sheet of glass. But, bit by bit, the air became colder and colder, and the crew had to wrap themselves up in warm coats made of skin and fur. At night it was very cold indeed.

The North Pole Star shone out in the clear dark sky, and often, as Henry Hudson looked at it, his heart beat with joy, for he knew he was going right. But it got colder still. The spray from the sea froze on the ropes and the sails of the ship, and it was as much as the crew could do to keep warm. They felt sorry they had gone so far, and they began to wish themselves safe home by their firesides. One of the men even said that if he had a hundred pounds he would gladly give eighty of them to sleep once more in his bed. This was told to Hudson. He was vexed that his men were so much afraid, but he did his best to cheer them and make them glad.

The crew became happy for a time, but soon they went past the place where other sailors had been before them, and got into a sea which not one of them knew. Large masses of ice floated about in the water, and every now and then one of them struck the ship with such force that it shook in every timber. The men were afraid the ship would be broken to pieces.

Now thick fogs came on, and Hudson could not see which way to steer the ship. On and on it went, however, very, very slowly. One day they reached a fair island, where they once more saw the sun and felt its warm rays. There was no snow, but herds of deer roamed about, and a large number of sea-fowls flew among the rocks on the shore. Here the crew wanted to stay, but Hudson knew that if he stayed too long the summer would be gone before his work was done. In the depth of winter he could not make a voyage in such a place. Much against the crew's wish, he pushed farther on.

Now the crew felt very angry with him, and, had they dared to do it, they would have put him to death. Then for several days things went on very well, but Hudson could see from the men's looks that they were not happy. He felt that their trust in him had gone.

By good fortune the sea opened out, and there lay before them a wide stretch of water. Hudson thought at once that it was the way which he was trying to find. But he was wrong. It was only the bay which we now call by his name—Hudson Bay. He sailed on, however, keeping as near to the shore as he could. He hoped to find a harbor there in which he could spend the winter. No harbor did he find. The men were downcast in spirit, and still wanted to return home.

One night the ship stopped. There it was—frozen fast in the ice. The crew were not able to take it on nor bring it back.

"The ice was here,
The ice was there,
The ice was all around."

The crew thought that they would surely be frozen to death, or that they would die of hunger. "We shall never see our homes again," they said. "Our little ones will cry 'Daddy,' and there will be no daddy to speak to them."

Do you think Henry Hudson was now afraid? No. He felt sure that the ice would one day melt, and that he would be able to go on. Do you think Hudson's little boy was afraid? No. He was not, for his father was in charge of the ship, and his father he could trust.

Spring came. The ice melted, and once more the water played about the ship. Hudson made up his mind to go forward next day. Safe in their cabin, Hudson and his son lay asleep, but the men were on deck. They trod softly and spoke quietly, for they did not want to be heard. Why was this? I will tell you. They were trying to agree what they should do with Hudson, so that they might go back home at once and not be made to sail on.

One of the men said, "Let us kill him, and then we shall be able to please ourselves." They had thought of doing this before, but the crime seemed to be too dreadful, for after all they liked their brave leader. He had always been good to them. They thought, too, what a sad thing it would be for John. Poor little fellow! how he would miss his father! Out on the wide, wide sea, in a part where no man had ever been before—how sad! No, they would not kill him.

Among the men was one whose name was Henry Green. When he was young he had got into a scrape, for he was always very idle. Hudson had taken pity on him and helped him, and when he wanted men for his ship he chose Henry Green to be one of them. He thought that, as "one good turn deserves another," Henry Green would be a friend to him if he should need one.

Alas! Henry Green was of all the men on board the most bitter toward Hudson. In his heart he was a coward, and his evil mind led him to ask the other men to do a dreadful thing.

Morning came. Hudson and his son stepped on deck from their beds. Both looked fresh and strong. They were ready to go on. All at once both father and son were seized from behind. Looking over his shoulder, Hudson saw that his foe was Henry Green.

"Why, Green," said he. "What now?"

"Wait and see," was the gruff reply.

Little John knew at once that there was something wrong, but he kept a brave heart, for his father was a bold man, and all would yet be well.

"Green," said the little boy, "I would kill you if my arms were free. My poor brave father! What has he done?"

Green smiled a smile of scorn, but the hearts of the men who stood round were touched, for they liked the pluck of the little fellow. They were for changing their minds, but Green shouted, "Now, men, each to your work!"

A boat was let down into the waves at the side of the ship. A little food was put into it. Then Hudson and his boy were gently dropped into the boat. The ship-carpenter was next put in. It was thought best to get rid of him, for he had spoken on his master's side and was likely to be his friend.

There were sick men in the ship—men who could eat, but who could not work. Their hands were frost-bitten. They were of no use. These, too, were dropped into the boat.

Hudson looked at the crew as the men leaned over the ship. He watched them as they cut the rope that held the boat fast. The boat and the ship parted company. "Men," cried Hudson, "you are brutes! God will punish you. You will come to harm."

The sails of the ship were spread, and soon a fair wind took the vessel away. The boat drifted out to sea. Across the waves came a faint cry, but the wicked crew laughed and thought they were having fine fun. Not till "the sea shall give up her dead" shall we know the fate of Hudson, his boy, and the men in the boat.

What became of the crew we know full well. They went through many trials. Not one of them could steer the ship as Hudson had done. Soon they could not agree. Food became scarce. Some died. Henry Green was the cause of their troubles, they said. They threw him overboard into the sea. Then the ship broke up, and the men that were left took to a boat. More men died of cold and hunger. What a sad plight they were in, to be sure!

For days and days the boat drifted about in the sea. Now all their food was gone. They lay down in the bottom of the boat, as they thought, to die. The boat was seen. John Waymouth, a fisherman of Fowey, in Cornwall, was out with his smack on the west coast of Ireland. He saw what he thought was an empty boat dancing up and down on the waves. He neared it and beheld the men. John Waymouth took them on his own ship and landed them at Plymouth.

So great had been their hardships that not one of the men ever grew strong again. They were indeed, as Hudson had said they would be, punished for their sin.

It is well for little boys and girls to know of brave men like Hudson and brave boys like his son John. Through their boldness and courage the world has been opened out to us. We know that not every country is like our own, that not all people are like ourselves. There are cold lands; there are hot lands. There are people white, and black, and brown. Yes, there are yellow people too.

A JOURNEY IN GREENLAND

It seems strange that a country to which the first sailor who saw it gave the name of the "White Shirt," because he could see there nothing but snow and ice—it seems strange, we say, that such a country should have come to be called Greenland. Perhaps it was so named by some early visitor who wished to attract settlers to that part of the world. Or it may be that what he saw of the land *was* green, and that he thought the whole country must be the same.

It is in the same part of the world as that to which Henry Hudson and his little boy went.

I will tell you the story of a journey that was made across this country. The journey was made not very many years ago. The traveler was a Norwegian named Nansen. Please do not forget that the country is very, very cold.

Nansen was a young man of a bold and fearless nature. To spend a holiday he went with some friends to catch seals off the coast of Greenland. His ship was ice-blocked for a time, and while he was thus forced to stay he saw a great deal of the people who lived near the coast. The people are called Lapps. When they want to travel over the snow they do not use the same kind of boot that they wear day by day. They use a sort of snow-shoe which they call "ski."

The skis have a wide and flat bottom, and, as the foot is pressed on the snow, they cover up a large space. The snow beneath the large space is, of course, harder and firmer than if the space were small. The skis, too, are light, and should the traveler wear them all day and make a long journey on them, they do not tire his feet. The skis, you see, are of great use.

Nansen knew how to use these "skis," and he said to himself, "I should like to cross this country and find out something about it." But as yet he was not ready for the journey. He came home and waited.

Nansen, like Hudson, was a poor man, and he had no ship of his own in which he could travel. But, as in the case of Hudson, a gentleman who had heard of Nansen's plans found him one. He was a Danish merchant who took much interest in men who wished to travel. The merchant also gave Nansen some money, so that he might buy for himself the things he knew he would need.

Nansen, of course, knew what he would want better than any one could tell him, so that the gift of money was a very useful one. Need I tell you that he spent it well and with care?

The men he took with him were five in number —three from his own country, Norway, and two Lapps. All these were used to skis.

The animal that is mostly used for drawing heavy loads in Greenland is the reindeer. They are very sure on their feet and do not slip much on the ice. Sometimes, however, dogs are used.

What we should call a cart is there called a sledge. You know that a sledge does not have wheels. Wheels would sink in the snow. A sledge has a flat, smooth wooden bottom which glides *on* the snow. Nansen meant at first to get a team of reindeer, but, when he thought the matter over, and talked to his friends about it, he changed his mind. He only took men, for the reindeer would have wanted a great deal of food, and that would have meant more things to carry.

On this journey each man drew his own sledge, and he carried on it everything he would want. The sledges were made light and strong.

Would you like to know what the men put in their sledges? I think you would, for then you will see how useful the present of money was to Nansen. Well, first of all, they took plenty of clothes. These were made of strong homespun wool, not of skin, as most others were in that country. Fur clothes Nansen would not use at all. The large overcoats had hoods to them which could be drawn over the head at the back, and the caps had flaps which could be let down over the ears.

Each man took plenty of socks. These were of wool too, but they wore over them a stout pair of other socks made of goat's hair. This kept out the wet, for, as you know, water and snow will soak through wool.

For sleeping in at night, Nansen had two large bags made. Three men slept in each bag. The bags were made of reindeer skin, and they had a large flap, which, when strapped down, held the sleepers firm and kept them warm.

Gloves were taken as well. These, too, were made of wool. Each man had also a pair of blue glasses for his eyes. The glare of the white snow should not hurt them, if Nansen could help it. But even this was not all. Each man had a tent and a spirit-lamp, a gun, ball and shot, an axe, several sharp knives, ropes, and many other such useful things.

Now as to their food. They took plenty of cocoa, tea, coffee, and condensed milk, but no strong drink, such as wine, brandy, or beer. Dried meat, cheese, and biscuits were their solid food. Each man, you see, had quite a heavy load to draw in his sledge.

Men had tried to cross Greenland before, but they had every one failed. They had always started from the west and tried to get to the east. Nansen took the other course. He started from the east and went toward the west. He had a reason for this. The west coast was the one on which most people lived, for living on the west was warmer and more cozy than living on the east.

Nansen chose to start from the worse and aim for the better. This was a very wise plan as it proved. When Nansen and his men had gone across the sea, by ship, and had landed on the coast, he gave himself and them this order: "Death or the west coast of Greenland." Every one agreed to obey. It meant that they would either cross the country or die in trying to do so. They were all men of pluck, but I hope you do not think they were about to try to do an easy thing. What they were going to do was very hard indeed.

Think for a moment of the country. There were no pretty lanes, with grass at the sides and trees hanging over, so as to form a shade. There were no woods or fields, no brooks or pools. Away from the coast there were no animals or birds. Look which way you would, you could see nothing but ice and snow. Sometimes the snow would lie flat, as though it were a field. In other places it would rise up and look like hills. The sides of the hills would be sharp and cutting. At times they sloped gently, at others they were like steep housetops, but very much higher.

It was summer-time. The sun shone on the snow and made the top of it soft, and the snow sparkled like diamonds. This hurt the eyes, and the sledges sank into the soft snow. So, instead of going by day, they went by night. At first, a night's journey took them two or three miles. They slept during the day, and at night took up their task again.

By and by they had used all their water. There was ice and snow around them in plenty; but they could not drink that. What do you think they did? Each man had a flat flask. He filled it with snow and held it to his body so that it would melt. Water for cooking use was made by boiling the snow over the lamps.

After some time they got to a place where the snow, instead of being flat or steep, lay in the form of waves—up and down. These were very hard to cross. The air became much colder, so that they could not travel by night. All the men were very tired. To lighten the sledges, they burned the oilcloth with which they covered up their clothes. With the fire they boiled more snow and warmed themselves. Before this they had not seen a fire for some time.

I ought to tell you that they burned the oilcloth inside one of the tents. How it smoked, to be sure! There was no outlet for the smoke, and soon their faces were as black as soot. When they looked at each other through the smoke, by the light of the fire, they had a good laugh. It was a nice piece of fun for them. Indeed, it was the first they had had since leaving the coast.

Nor did they wash their faces. Had they done so they would have been frost-bitten. Their skin would have become rough and sore, and, perhaps, it would have peeled off. So they left them dirty. There was no one besides themselves to look at them, so that did not matter very much.

They started once more, and this time in the face of a very strong wind. It caught up the loose snow, and as it blew in their faces it nearly blinded them. Their glasses were of little use, for the snow covered them up, so that they could not see through them.

Now they changed their course and made sails for their sledges, so that the wind might help them along. On they went. By and by they reached a level tract which Nansen himself called "an ocean of snow." There were no blinding snow-storms here.

For some days there was no change. Flatness and whiteness were the two chief things of this "ocean of snow." In the day the men could only see the sun and sky, the snow-field, and themselves. There was no object to rest the eye upon. There was nothing to guide them but the compass they had brought. The stronger men of the party made their way to the front, the weaker ones lagged behind. This, on the whole, was useful, for on looking back the first could tell whether they were going straight or not.

The nights were very beautiful. When evening began, the sunset was grand. After the sun had gone down, the sky was still lighted up by many lights of all colors. But the air was very, very cold. As the men slept in their bags, their bodies were warm, but their breath froze on their lips so that at times they could not open their mouths. Their noses froze, and they had to rub them with handfuls of snow. Throats and hands were frozen too. Then another snow-storm came on. It covered up their sledges, and only the tops of the tents could be seen. Before they could start, the sledges had to be dug out.

Every day was like the last, and only now and then, when they rested for food and warm cocoa, had they the least joy. For some time they had been climbing, and this was one of the reasons that they felt such great cold; but they found that at last the way began to slope downward. It was easier now, and they went along much more quickly. It got warmer, too, and their hearts became light. Would they soon finish the journey? They hoped so, and they felt sure that they could not be far from the west coast.

One day they saw a bird—a snow-bunting. It was the first sign of life they had seen for thirty-four days—more than a month. Now they joined two sledges together, and again made sails for them. They sped along at a rapid rate, and the one who had charge of the sledge had as much as he could do to keep a straight course.

It was a good thing that the man who took the lead was steady and careful. His sledge was going so fast that, had it not been for his skill in stopping it, it would have fallen down a steep hill of ice that lay, unseen, in front of him. He shouted to the others, who were able to stop their sledges in time to prevent a mishap. Had they fallen, this story could not have been told. No one would have been left to tell the tale.

In two days more "Land ahead!" was shouted by one of the Lapps, and the whole party gladly took up the cry. With hopes high, and hearts made light, on and on they pressed. Night overtook them, but they did not stop. Down the slope of snow they slid, and the wind helped them along. Nansen on his skis shot ahead to try the strength of the snow. The sledges came safely behind. The moon rose. Men and sails and sledges, floating in front of the wind, were the only black spots in that vast tract of snow.

Soon large cracks were met with. They were too wide to leap over. A halt was called. Next morning the men beheld a glad sight. They came upon a stream of fresh drinking-water, and drank of it again and again. They had been thirsty for a long time, as you know. How they ran and danced about, to be sure! They were like men just let out of prison, or like boys let out of school to play. They cheered, they shouted, they cheered again.

The camp that night was a merry one. They lit fires and burned the short scrub, which grew in thick masses around them. They filled their pipes and smoked the moss that grew at their feet. Never had they been so happy before.

Then, after a time, they came to a creek. But how to make a boat to carry them down was a puzzle. The canvas of the tents was used, and in a boat made of canvas, bamboo, and rushes they started by sea once more. The boat leaked badly, but, by dint of bailing out the water, they got a little distance, and then took to the coast again.

Sea-gulls were now seen in plenty, and they were shot for food. Sea-urchins were found. These were boiled for soup. Berries grew on some of the bushes. These the men ate with great relish. In the valley below, smoke from chimney-tops curled in the air. A town lay on the coast. Friends lived there. They were glad to see the weary ones. Their journey was at an end.

THE NEW WORLD

There was a time when our country, which we call America, was not known to the people of the eastern part of the world. When news was brought there that this land had been found out, men said to each other: "A new world! A new world has been found!" They little thought that the name would last so long. America is still called the "New World."

The honor of finding it is given to Columbus, though he was not the first sailor of Europe to set his foot on these shores. Before his time, a party of men had been here from Iceland, but that seems to have been forgotten. It is only fair to say that Columbus had never heard of it. Columbus was born at Genoa, in Italy. As a boy he was very fond of reading about the sea. The book he liked best was that in which he read the travels of Marco Polo, who was also a native of Italy. You are not surprised now to hear that when he became a man he was a sailor. But he was not content to sail along the coast, keeping in sight of land all the time. He had a strong wish to go farther. Often, as he stood on the beach and looked across the sea, he wondered what there was beyond the sea-line out of sight.

Sometimes he saw driftwood and strange seaweed washed up on the coast, and he could not help but think where such things came from. As he thought, he said to himself: "Is yonder sea-line the end of the world? If not, what is there beyond? In the ocean are there other worlds? Can I sail away and find them?"

It is quite plain that he could not go alone. He must have strong ships and stout-hearted men. Of these he had none, and when he told his plans to rich men, they laughed at him and bade him begone. They said he was a foolish man to think such nonsense.

About this time his wife died and left him with a little son, Diego. He put off his plans for a few years, till Diego should be grown big and could be left with friends.

The more he thought of what there might be beyond the sea, the more Columbus wanted to go and find out. He went to Genoa, his native town, and tried to get the merchants there to help him. But, alas! he failed once more. Not wishing to be beaten, he went back to Spain—that was where he had been living when his wife died. Diego held his father's hand as he walked along, and the two looked very sad. Both were weary and footsore. On the way they came to a convent. The kind abbot asked them in. He gave them water to wash themselves, new clothes and boots to wear, and good food to eat.

After several days, during which Columbus told the abbot of his plans, he went away, leaving the child Diego in the abbot's care. The abbot gave Columbus letters to the King and Queen of Spain, for he thought they would be of use to him. At that time the King was in camp with his soldiers. Much money had been spent in making the camp look grand, and more still in making merry with games. Oh that Columbus could have had some of the money which he felt was being wasted in this way! With it he was sure he could find the far-off land.

The letters which the abbot had given him to the King and Queen proved to be of no use. The King read them, and both he and the Queen were pleased to think they had been asked to help. But they would not throw money away for such a mad purpose.

Poor Columbus! Was he sad now? He was, but he would try some one else. He next started to go to the King of France. It was seven years since he had first formed his plan, and he was vexed that he could get no one to think as he did.

On the way he paid a visit to his boy. He stood again at the convent gate, and asked for a crust and a cup of cold water. The abbot again took him in, and was so much struck by what Columbus told him about the sea, and what he had found on the shore, that he bade him go back and ask to see the Queen. Columbus also showed him some charts and maps he had drawn, and said that if he did not find a new world he should get to know a new way to India, which would be shorter than the old one.

Back to the court of Spain he went. After a great deal of trouble and loss of time he saw the Queen herself. He had a long talk with her and she was pleased. But that was all. He had not asked for much help—only a few ships and men; but these he could not get.

On his way back to the convent, while going through a deep valley among the hills, he heard some one calling him. It was a man whom the Queen had sent to ask him to return. She had changed her mind. With the man he once more went back. This time he gained what he wanted. By the Queen's command the city of Palos was to find two ships. These Columbus got, and, by a stroke of good luck, a rich friend found him a third. This was the "Santa Maria." The ships found by Palos were the "Pinta" and the "Niña."

Now men came forward and said they would make the venture with Columbus. Soon he was able to choose a hundred and twenty, not one of whom had ever been out of sight of land.

Early on the morning of August 3, 1492, the sun rose warm and bright. A large number of people had come to the port to see the ships start. They knelt on the beach in silence, and offered up prayers for the safety of the men and the ships. There was no fun now. The hearts of those left behind were sad at parting from those going they knew not where.

Away they went. Soon land was lost to sight. They grew very sad and fearful, and wanted to return. But still they went on. Every morning they looked across the sea, and strained their eyes all day long, in watching the long sea-line, "where sea and sky together meet." At night they went to rest, feeling they might never see land again.

Thus many days and nights went by. Out toward the west, away to the east, to the north, and to the south there was water everywhere—but no signs of land. To cheer the men, Columbus offered them large rewards and rich presents. This kept their hearts light for a time, but over and over again they wanted to return. Now a man would climb the mast and shout: "Land! land!" The others would climb to catch a look at it, only to find out that a mistake had been made. So many times had this been done that the men lost heart more than before, and Columbus had to say that he would flog the man who gave a false report.

At last the men on the "Pinta," which was the fastest ship, called out that they could see a torch away off to the west. "A torch?" every one asked. "Then it is carried by hand. There must be land where people are."

Night kept the land from being seen, but it was there. They could still see the torch, and, what was more, it was being taken from place to place. Now it was hid from view, now it could be seen again. Then it went out of sight once more. At daybreak every man on board the "Pinta" was on the lookout, and sure enough a low-lying coast seemed to be in sight. Nobody, however, was bold enough to cry out, "Land!" for they knew what Columbus had said.

The day wore on, and the "Pinta" still kept in front of the other ships. In the water plenty of seaweed was seen, and one of the men even caught a crab which had stuck fast in some of it. Surely what they could see in front of them must be land!

"What is that moving?" asked one. Then with a burst of joy the man on the mast gave the cry: "Land! land! land!" He was not afraid now. He could see it quite plainly. People were moving about and rushing from place to place on the beach. They had seen the mast and sails of the "Pinta" with their sharp eyes, and were much afraid. "What could it be?" they asked one of another. They had never seen any such thing before.

Sails were taken down from the "Pinta," to allow the other vessels to come alongside. The sailors on the "Niña" and the "Santa Maria" heard the cheers of the men on the "Pinta," and as they drew near they too saw the land. There was no mistake this time. Weary with looking at sea and sky so long, the sight of land quite overcame the poor fellows. Oh, how they cheered! It was not so much for themselves, nor yet for the land, as because of the pluck and skill which their brave leader had shown. In spite of the cries of the men from day to day, he had kept firm in his faith that land there was, and that sooner or later they would come to it.

By and by a boat was let down, and a few men from each ship got into it. Then they rowed swiftly toward the shore. Columbus, dressed gayly in his best, with his sword in its sheath as a sign of peace, and with his hat in his hand, stood up in the boat and made signals to the people on the beach. They looked much afraid, and withdrew a little distance. This gave Columbus and his men the chance of landing.

As they stood on the firm sands and looked about them, they thought they had never seen a land look more beautiful. Then they fell on their knees and gave thanks to God who had brought them safe across the deep. They begged Columbus to forgive them for the pain they had caused him from time to time. They kissed his hands and wept for joy.

The natives, who had been watching these things from behind the trees, now took courage and came nearer. The glitter of the fine clothes and armor made them crouch with fear. Once more they fled. By signs Columbus asked them to come to him. He knew he would not be able to talk with them, but he felt that he could make them understand a little if he had the chance of being near them.

They came. They pointed to Columbus, whom they knew to be the chief, and then to the ship. Then they pointed to the sky. What do you think they meant? If they could have used words, this is what they would have said: "We see you have come, but whence we know not. Is it from the deep blue sea, or from the sky above?" Columbus showed them his hands, and let them touch and feel them. That would give them trust in him, he thought. Then after touching his smooth hands they fell on their faces as though he were a god.

What a sight! Think of it—white men dressed in gay clothes standing on land, which they saw was very beautiful, and at their feet, with faces hidden in the sand, a host of naked, dark-skinned men and women. Little boys and girls played about. Their chatter and laughter mixed with the singing of the birds. These were the only sounds which were heard. The children pointed to the strangers, and then, as they turned to each other, made faces of wonder and awe. The youngest of all hid themselves behind their mothers' backs.

From the color of the people and from the looks of the land, as well as from the way in which he had come, Columbus thought the country was India. He gave it that name, and even to this day the group of islands near our Southern States is called the West Indies.

One by one the natives got up from the sand, and as Columbus pointed to his mouth and to his men, who were doing what they saw their leader do, they ran and brought water and fruits. Bit by bit, the natives became quite friendly. Columbus stuck a spear in the ground, and on the top of it the flag of Spain. In this way he claimed the land for the Queen who had helped him to find it.

The natives became curious as the day wore on. They stroked the fine dress of Columbus, and looked at his sword. They knew that the sword and spears were for fighting, and they showed him that they too could fight. They had large clubs, which were hard and strong, and made dreadful by means of sharks' teeth stuck in the knobs. They had wounds on their bodies and on their faces. They seemed to be proud of these, and wished to find out what signs of war Columbus had.

By evening Columbus became anxious. He wanted to go back to his ship and tell the others of his luck. He went toward the edge of the water, where his boat was made fast, and pointed to it and to the ship. The natives understood what he meant. They let him and his men get into the boat, and row away toward the ship, then they jumped into the water and swam after it. Swimming was as easy to them as walking. A few sat in their own boats or canoes. These were logs of wood with a hollow burnt out, or frames of wood covered over with skins. They managed them well, and paddled them through the water pretty fast.

When they came to the ships, they watched Columbus and his men enter them, and after swimming or paddling round and round them many times they at last went back to the shore. Not one of them could Columbus get to go into his ship with him. They must have talked over this strange event till far into the night, for Columbus could see torches carried about and fires burning on the beach.

At daybreak the three ships were taken nearer to the shore, and a safe place was found at which to drop anchor. The natives danced about and shouted in a strange way. Then they stood back a little for Columbus to land. All that day Columbus tried hard to find out the worth of the land. The people were poor. Fruits they had in plenty, but there was not a coin of copper, or silver, or gold in use.

Columbus thought that, as he could find no money, or gold, or silver, the natives had hidden it. So he showed them beads and chains of gold, but they only laughed at them and showed their white teeth. Of their use it was quite clear they knew nothing. Some one must have taken the news of the coming of the white men across the island, for by and by fresh natives came and brought presents of fruits.

At night Columbus again returned with his men to the ships. For a time they talked over what was best to be done. They all agreed that it was of no use to stay there, but what could they take home to show the Queen and their friends that they had been to a new land? Next day they tried to get a native on board their ship that they might take him as a sign. It is said that one more bold than the rest did get as far as the deck, but the moment he was there he jumped back into the sea.

After taking a new stock of food and water, Columbus and his men turned once more toward Spain, where in due time they landed in safety. When it became known that the voyage had turned out well, every sailor in the city wanted to go, and rich men offered to find ships for them. Many went, and brought back the same account that Columbus had brought before them.

Of what use was this voyage of Columbus to the Old World? I will tell you. Columbus found for people in the Old World a new home in which to dwell. Nobody can tell what would have taken place in some of the old countries if every child had had to live in the country where he was born. People always live where there is work to do, and the Old World was too crowded for everybody to live and work in with comfort.

To the New World many came. No sooner did one family come than they sent word to their friends how much they liked it and how well they were getting on. Then they too wanted to come. At first it was very hard for them. The men of Spain had tried to cheat the natives and rob them. They made them believe that glass beads, which are of very little value, were worth a great deal. The natives gave them fruits and grain of all kinds for them. But they soon found out that they were being robbed. Then they were angry, and fought with their clubs against them. Sad to say, they were nearly always beaten.

Columbus had only seen a very small piece of the country. He had, in fact, only been to a very small island of it. Afterward it was found out that the land near was of vast size. Everything in it was large—large rivers, lakes, mountains and plains, large forests. Before the land could be of use the trees had to be cut down, and spaces cleared for homes and fields. Then, as this was done, the natives saw that they were losing their land, and were being driven farther and farther away from the coast into the middle of the country.

Do you think they liked this? Would you have liked it? No. The natives were very angry, and they tried their best to prevent it from being done. But wherever white men have gone they have always showed that they are a race of men more clever than men of color, red or black—and sometimes not less cruel!

When you grow older, you will read much of the fighting which the first people who came to the New World had with the natives. From the color of their skins they were called "redskins." Many thousands of these people still live in different parts of North and South America, and they are much better treated by white men now; neither do they cause the white men much trouble.

NAPLES—IN ITALY

"Why did Uncle Tom say: 'See Naples and die'?" asked Katie Smith one day of her father as she sat on his knee on the lawn.

"I was just thinking of Naples, my child," said Mr. Smith, "and I will tell you what you want to know. I think it will please you very much indeed. Everybody who has seen Naples thinks it is the most charming place in the world, and that one need not go to any other place to see any of the beauties of the world. Much can be learned from a visit to this famous city."

"I should like to see Naples," said Katie, "but I do not think I should like to die then, for I am sure there must be other places I should also like to see."

"Well, let me tell you of Naples," said Mr. Smith. "Naples is a city in Italy. To get there we have to go by ship, and the distance is very great. When I went there a few years ago, when you were quite a little child, I got there at night. It was in the month of May.

"The captain told us that we could not land till morning. That did not matter very much. Indeed, I was more pleased than if he had sent us all ashore. The sea was calm and still. The city was lighted up by many beautiful lights. The houses rose one above another on the slopes, and the whole place looked very grand.

"Right at the back of the city was something I had never seen before. It was a mountain which threw out fire and smoke, and which sometimes throws out melted rocks and other things—a volcano, you know. The smoke above the mountain was as a mass of black clouds, by which the light below was made all the more clear. There is nothing like it in our land now, although long, long ago there were volcanoes here of the same kind. We call those mountains 'extinct' volcanoes because they no longer throw out fire and smoke and the melted things I have spoken of.

"The sea, as I told you, was calm, and the water was like a large looking-glass. In it could be seen the same red light from the mountain over again. The people in the ship were all on deck, and every one of them was glad to see so pretty a sight.

"All round the ship were men in boats. They came near enough for us to hear their voices, for they hoped to be able to take some of us on shore. When they found out that we were not going to land till morning, they got their boats together and sang us some pretty songs of their own country in their own tongue. I could not tell a word they sang, but their voices were very sweet, and as the music floated to us we were more than pleased. Then we watched them rowing back to the shore.

"Many stayed on deck for a long time. As I was tired, I went to my cabin so that I might be able to get up early in the morning and see the beautiful sight again. The morning scene was not the same as at night. The sun was high in the sky, and there were no clouds. A pale gray smoke from the mountain was rising into the sky, so slowly that it seemed as though it were lazy and did not want to rise at all. The town was a grand sight. The houses were white, with flat roofs, and as the sun shone on them the sight was really beautiful.

"Many of us let the boatmen, who had come back to the ship, take us to the shore. My boatman was a very jolly fellow. He sang as he rowed the boat along.

"As I had made up my mind to stay in Naples for a week or so, I was in no hurry; but nearly everybody else was going back to the ship that same night. They were going to travel farther.

"The streets were very narrow. I was not much pleased with them. But I made the best of it and walked on. Naples is a very old town. It has been famous for more years than I can tell you. A long time ago two cities stood near, but a sad thing befell them. One night the volcano sent out more heat and smoke and melted things than usual. It was soon seen that something dreadful was going to take place.

"You ought to know that inside the mountain the rock is in a liquid state. It is called lava. Sometimes, as well as the heat and smoke, the lava comes out as I have told you, and it flows down the slope of the mountain. This is what it did on the night I am telling you about. The people in one of the cities were all doing just what they did every night. Some were walking in the streets, others were at home in their rooms and in their beds. Some had gone to see their friends, and were laughing and singing and making merry.

"They heard the roar of the mountain, but, before they could get away, the lava ran down the sides of the mountain into the streets of the city. Soon the houses were covered up, and by morning the city was quite hidden from view. The people had all been buried by the lava.

"It was very sad, and perhaps you wonder how all this is known. I will tell you. Men have been digging with spades and pickaxes and have taken away a lot of the lava, which is now cold and hard, and have come to the old houses that were buried. They have found them just as they used to be. They have found even the bones of the people all covered over by the lava.

"In a house in Naples I saw a great many of these, and one day I went to see the buried city itself. It was low down in a hollow, and to get to it was something like going down into a coal-mine. We had to use torches and take care where we trod.

"The other dead city was covered up by the ashes which came out of the volcano, and these have now been taken away, so that the city may be seen as it used to be. It has been much easier to move away the ashes than the lava, and the ruins have been left more perfect.

"You may, if you like, call the buried cities the 'cities of the dead,' for as we tread the silent streets the feeling comes over one that they are cities still, though the people are no more. On the pavements of some of the streets are still the marks of the wheels made by the chariots which the people used in those days. The things in the shops are there just as they used to be, and in the city which was under the ashes I saw a drinking-fountain at which were still the stones that were worn smooth by the tread of the people's feet. Loaves are still in the ovens, though of course the fires have gone out, and the baths where the people washed are still as they were in the days of old.

"In this city I saw one of the saddest things I ever saw in my life. It was a cast of a woman with her child in her arms. When she heard the roar of the mountain, and felt the falling of the ashes, she picked up her child and tried to run away with it to a place of safety. She was, of course, overtaken by the ashes, covered up by them, and there a model of her may be seen.

"I saw the cast of a dog, too. He lay on the ground with his feet in the air. His face looked as though he were asking his master what he could do to get away from the falling ashes.

"The visit to these cities made me feel very sad, and very sorry for the poor people. I watched men still digging, and, although it was so sad a sight, some day I hope to go there again and see what else they have found."

Katie sighed when her father told her all these things. She shook with fear when he went on to say that he one day paid a visit to the mountain which had caused all this pain and loss to the people. "You need not fear, dear Katie," said he, "for many people go there, and no one is hurt. The mountain is quiet now. I hope it will always be so." Katie hoped so, too.

ACROSS A DESERT

In the present section of this book you read of the cold, cold North. Now we will turn to a country of quite another sort, to a land where no rain ever falls and where the soil is hot, dry sand. Such a place is called a desert.

Ali Babel was an Arab. He had a large coffee-farm at a place called Sadwan in Arabia. Every year he made a journey to the seacoast so that he might sell his coffee to the merchants there. The country round about Sadwan was very beautiful. A stream flowed through the village, and date-palms grew in hundreds along its banks. It hardly ever rained there, but still the grass was green and plants of many sorts grew, for the roots were kept moist by water taken from the stream. The stream was called a wadi.

The coffee-berries were all stowed away in bags, and everything was ready for the journey. Ali Babel and his men would be away for more than a month, for the distance was more than five hundred miles. The way lay across a desert. Now a journey across a desert is very much unlike anything that most of you have ever known in this country. There are no railways in the desert we are speaking of, nor even roads. There are tracks sometimes which have been made by the animals, but even these are often covered over by sand and hidden from view.

People make the journey with camels and a sort of wagon. Sometimes only camels are used. Ali Babel only used camels. Of these he had a hundred and twenty. Ali Babel had a camel all to himself, and for the most part of the journey he rode on the camel's back. Sometimes, however, he walked for a change. His seat on the camel was a very cozy one. Sometimes he fixed a tent over his seat, which kept the hot rays of the sun from his head.

He took thirty men with him to look after the camels. The men walked most of the way, for each of the camels had a heavy load to carry. Each man had a gun. Why was this? The reason was that in the desert, which they had to cross on their way to the sea, lions roamed about, and it was not safe to go without something to shoot them with. Early in the morning the camels were taken down to the stream to drink. They drank a great deal of water, for camels drink as much at once as will last them for many days. Then water-bottles were filled, and when the packets had been tied on the camels' backs they were hung down at the sides. The camels knelt down while the packets and water-bottles were being tied.

Some of the camels did not carry bags of coffee. They only carried extra bottles of water and tents. The tents were for sleeping in at night.

Everybody in Sadwan came to see Ali Babel and his men start on the journey. The wives and children were left behind, for they would not be of use on the way. For some distance the people and the little children went with the party, but one by one they turned back and went home, to wait till Ali and his men came back. Ali Babel led the way, and soon the village was out of sight. There was now nothing but sand to cross.

For some time all went well, but one day at noon, when the sun was almost over their heads and they were all very hot, something dark came in front of them and covered the sky. Ali Babel looked at it with fear, for he knew that it was a sand-storm that was coming on. He would soon have to meet it, for it came quickly along.

He stopped his camel, and the men stopped theirs. Then all lay down with their faces in the sand, each behind a camel. The camels too knew what it was, and at a word from the men they buried their faces in the sand. Now the sand was on top of the men and the camels. It was very small in grain, but oh, so hot! None of the men dared to hold their faces up, for if they had done so the sand would have scorched and burned and perhaps blinded them. They hardly dared to breathe, and you may be sure each man wished it were over.

All at once, louder than the hissing of the sand as it struck the camels and the men, a loud roar was heard. A lion had been driven along with the storm, and as he came to Ali Babel's party he tripped over one of the camels and fell down. He gave that loud roar, and, as though he knew what was best for him to do, he lay down by the side of one of the men, behind the camel over which he had fallen. The man felt his warm body against his own, and heard the lion snort as he blew the sand from his nostrils. But the man dared not move, he was so full of fear. A few minutes seemed hours to the party. To the man next to the lion they seemed days.

By and by the storm ceased, and through the thin layer of sand on their backs the men could feel once more the burning heat of the sun. One by one they got up. All had heard the lion roar, but, save one man, they did not know what had become of him. He knew, for the lion was by his side.

A strange thing happened. The lion seemed to know that the men were getting up, and he too rose from his sandy bed. Without doing the least harm to any of the men or animals, he gave another loud roar and bounded away in the direction the sand-storm had gone. Was it because he was afraid of so many men? Or was it because he was thankful for the shelter the camel had given him? Nobody can tell. The lion soon made his escape, and not a gun was fired after him as he went out of sight. The men were thankful, you may be sure, for not one of them was in a fit state to shoot straight if they had had to fire.

Now there was trouble of another kind for the party. The sand had covered the track over which they were going. Not a sign of it could be seen. "The sun must be our guide," said Ali Babel, "and may the Prophet help us on our way." As far as the eye could see there was nothing but sand, and for some days the party went on picking their way as best they could. They hoped soon to come to the wells, where they would be able to fill up their water-bottles once more and take a little rest. They were footsore, and most of the water was gone. No wells did they reach, nor could they see any signs of trees growing where the wells would be. In another day all the water was gone, for no wells had they been able to find.

Ali Babel set some of the men to dig in the sand in the hope that water would be found underneath, while a few of the strongest of the party went forward to a hillock of sand to take a wider view. By and by they came back with the sad tale that, look in what direction they would, they could see no signs of growth of any kind. No water had yet been found by digging. What could they do? They must either lie down and die or kill a camel.

This killing Ali Babel was loath to do, for he loved his animals, as all Arabs do; but at last there was no help for it—a camel must die. With a sad heart Ali Babel gave orders that one of the camels which had borne the water-bottles should be slain. As the poor creature lay on the sand about to give up his life for the men, he looked up as though he were begging to be spared. But the man, with one deep, sharp cut, bled the beast to death. His body was opened, and the water taken out of his stomach. Poor Ali Babel turned his face away while all this was being done, for he could not look on the death of the animal with anything but pain.

The water thus got made the party feel fresh and strong, and they lost no time in starting on their way once more. It was sad work, however, and the pace they made was but slow. At night they made their tents and kept their watch-fires burning as usual, to keep away any wild beast that might be lurking about in that place, though none had been seen for some days. A heavy dew covered the sand that night. It was the first they had seen since a day's walk from the village of Sadwan. Next day the men rose much more refreshed than they had been of late. Surely water must be near, or why should there be a dew? This thought made the men more eager than ever to get on with their journey. So they started once more.

Again a camel was killed, and water was got in the same way as before. Another heavy dew that night gave the men new vigor. Again they started on their way as the morning dawned. Joy! joy! Trees were seen in the distance away from the track which they had found a few hours before. They made haste toward them, but the distance from the trees did not get less. What they had seen was only the image of trees hundreds of miles away.

Ali Babel now fell sick. The heat had been too much for him. To get water to bathe his face, another camel was killed. Less water was found in this than in the others, and the men felt very sure that the end of it all would be death in the lonely desert. They would have eaten the coffee in the bags, as all their food was now gone, but that would have made it no better for them. This they knew.

One by one the men sank down on the sand never to get up any more. There in the desert they died, and their bodies were left to bleach in the sun, as those who were alive were too weak to bury them. Several of the camels died, too. The party could now no longer keep together. Only the strongest were able to walk at all. With much courage these held to the journey. They were fighting the foe of hunger and thirst.

There was now something in the distance. What could it be? Trees again? No. It was something that moved. Nearer and nearer it came, and the dust that rose in the air was a sign that it was another party of men and camels coming toward them. With a faint voice and a promise of reward Ali Babel urged his men on. There was a chance of rescue from the awful death that stared them in the face. Now the parties met. Water-bottles were opened in haste and drink given to the thirsty and fainting men and animals. They were saved.

By good fortune the wells were near. The party which had met Ali Babel turned back to refill their bottles. How glad the men were to be safe once more! They thought that water had never tasted so good. It made them all feel fresh and strong and well.

After a rest of a few days, during which they ate of the dates of the palm-trees which grew there, they filled their water-bottles and took some of the fruit. Then they started once more on their journey. They found themselves out of the beaten track a good distance, but after a time they reached the town to which they had hoped to come, feeling sad at the loss of so many lives on the way.

THE LAND BENEATH OUR FEET

No tales of travel would be enough if they did not tell you something of Captain Cook. It was Captain Cook who first went from England to Australia, the land beneath our feet.

This brave sailor had set out from home to sail all round the world. On his way back he dropped anchor in Botany Bay, a place in the land beneath our feet, and landed on the coast by means of a small boat. When at last he got to England he was greeted with great joy, for he had been away so long without being heard of that every one thought he was dead.

He told the story of his travels, and many wanted to go with him to the land beneath our feet if he should start out again. This he did. He sailed to the distant and unknown South Sea Islands, which lie beneath our feet, and learned what had never been known before about them. He found a very savage race of men there. But, as he was very kind to them, they got to like him and did not try to do him any harm.

At last Captain Cook met with his death in a very sad way.

Some of the natives had stolen one of his boats which he had made fast to the shore of one of the islands. They had taken it to an island not far away from where he was. When he had missed his boat and had learned where it was he set off to get it. The natives withdrew a little and let Cook land. When, however, they saw that he was alone, they fell upon him with their clubs, and beat him to death; for what could he do against so many? They took his body into the woods, and it is thought that it was eaten. The natives were man-eaters, or cannibals.

The seasons in the land beneath our feet, that we call Australia, are not like ours. When we are reaping our grain the people there are planting or plowing. Our fruit-season is over when the trees there are starting to bloom. Our Christmas Day comes in the depth of winter, when often snow covers the ground. Theirs is at the time of summer's glory. We sit round our fires and chat. They have picnics in the fields and woods.

When Cook got home and told of the strange country, men wanted to go there to live. A great number went, and found that they got on very well. After a time gold was found there. Then there was a rush of people. Everybody wanted to grow rich by picking up lumps of gold. It was an easy way, they thought. They went in hundreds and thousands at a time, and so eager were men to get to the gold-fields first that they were said to have the "gold-fever." This was just like what happened a little earlier, when gold was discovered in California.

The gold was found in lumps called nuggets, and men have been known to find as much gold in a day as to make them rich for life. These "finds" kept men from doing other work. There were few men to till the farms, to mind the cattle, to bake, to make clothes and boots; few men to keep shops in the towns; few policemen; not many sailors. It looked as though there would be great trouble in the country, and that its rich gold-fields would prove its ruin.

But things came right at last. The gold-seekers wanted food, so that the men who *would* bake did well. Clothes wore out, so that those who had a mind to make them were well paid. Workmen on farms and in gardens got good pay for their work. Gold-seekers ran risks of being robbed. Workmen were safe from this danger.

Before long the country settled down, and now it is known as the Commonwealth of Australia. Most of the people are English, their names are like many of our own, their manners and their modes of life much the same as ours.

INTERESTING QUESTIONS AND ANSWERS

WILL THE SUN EVER COOL DOWN AND HAVE THE SAME TEMPERATURE AS THE EARTH?

YES, this must happen. Indeed, the cooling down must go farther than that, and the sun, if it is to remain as the sun, must certainly become quite cold all through, which the earth certainly is not yet. This need not happen if the sun were to meet some other star, and by the force of meeting be made hot again; but then, of course, it would not be our sun any longer. Our sun would have disappeared, though the stuff of which it is made would remain.

To make something from nothing is an impossibility. Every moment, without ceasing, the sun is giving out enormous quantities of power in the shape of light, and heat, and other things. If the sun were all the time getting from somewhere else as much power as it is giving out, then, as long as that supply is kept up, it need not cool down. Astronomers have very carefully studied this question. The sun gets a certain amount of power from shooting-stars falling into it; it also gets a certain amount of power from the light of the other stars. This is nothing, however, to the power the sun is spending. It must necessarily, therefore, cool down, and become, we have no doubt, like the countless thousands of cold stars or suns which we know exist in the sky.

HOW DOES CAMPHOR KEEP MOTHS AWAY?

CAMPHOR, like most other things that have a smell, is what we call *volatile*—that is, it gives itself off into the air in the form of a gas. Like many other volatile things, camphor is an *antiseptic,* a thing that is very bad for the lives of microbes. Now, most things that are poisonous to microbes are poisonous to insects. Indeed, as a rule, a poison to any kind of life is a poison to all kinds of life.

Camphor in large doses would kill a man. The camphor gives itself off into the air around it, and as it is very poisonous to moths, when a moth smells camphor anywhere, it flies away. It is a great advantage when an antiseptic is volatile, and all the most useful antiseptics are volatile. If a thing is not volatile, it can only have its effect on anything that actually touches it, and perhaps not even then, unless the thing actually starts to eat it, which is not likely.

If an antiseptic, such as camphor, is volatile, it flies about in the air everywhere. Of course, as it spreads, the amount of it in the air gets less; and so insects or microbes can get within a certain distance and not suffer; but they cannot go nearer, or else they would be killed. Everything we use to preserve clothes in a drawer is therefore volatile, and so can protect the whole drawer.

WHY DOES WATER BOIL WHEN PUT ON LIME?

THE answer to this question depends on a very interesting chemical process which is not difficult to understand. Water does not exactly boil when it is put on lime, but it is certainly true that the water is made very hot; and so our question really is: Where does this heat come from? Lime, or rather quicklime, is a compound of the metal calcium and oxygen. It is therefore called the oxide of calcium, and each molecule that makes up this compound contains one atom of each of these elements; so chemists write it by this *formula* or sign—CaO—Ca standing for calcium and O for oxygen. If water gets to this oxide, the water and the oxide combine very powerfully. It is as if the quicklime drank up the water and slaked its thirst, and so we now call it slaked lime. This slaked lime is oxide of calcium plus water, and its formula is simply the two formulas added together, CaO, H_2O. The best way of writing this is $Ca(OH)_2$. The small 2 means that there are two parts each of oxygen and hydrogen. As in most other cases of chemical action—just as when a fire burns—heat is produced by this slaking of lime, and that makes the lime and the extra water that is added very hot.

WHAT CAUSES CHILBLAINS?

Chilblains are really a very mild kind of frost-bite. Cold is the beginning of it, but it is not merely the cold that does the harm; it is really *starvation*—starvation of a finger or a toe, or the nose, or the ear, because it is not supplied with enough blood; and the cold acts simply by shutting up the blood-vessels, so that the toe, or whatever it is, is starved. In what we call a chilblain, the toe or finger is by no means starved of blood. On the contrary, it is warm and red. But it *has been* starved, and now it has an extra supply of blood in it to make good the damage.

The surest way of getting chilblains is to wear very tight boots or gloves, to take no exercise, to get exposed to cold, and to keep hands and feet warm in cold weather by holding them before a fire, allowing them to get really cold before or after doing so. Children are specially liable to chilblains, because their tissues are delicate, and will not stand a little starvation, even for a short time, so well as the tissues of a grown-up person.

DO WE GET A POUND OF ICE FROM A POUND OF WATER?

When we use such words as pound or ounce, we are concerning ourselves with the notion of weight; that is a different thing from mass, of course. The mass of a thing is the amount of stuff in it. If we take a pound of water and turn it into ice, the mass of it will remain the same. We allow nothing to run away and we add nothing to it, so we have there the stuff which we had before, and nothing but that stuff; and the only question is: Does it weigh the same when it is frozen as when it was liquid?

Most careful experiments have been made on this very point, and all go to show very clearly that gravitation is not affected in the slightest degree by any change of temperature, however extreme. The amount of stuff which weighed a pound when it was liquid water weighs neither more nor less, but exactly the same, when it is frozen. We get more than a quart of ice from a quart of water because the water expands when it is frozen.

WHY IS IT THAT THE BAD AIR OF A MINE DOES NOT KILL THE MINERS?

The air of many a fashionable and world-famous New York shop, or of hundreds of thousands of bedrooms every night, is far worse than that of mines nowadays. Ventilation is one of the great problems of a coal-mine, and one of the very first that must be attended to. Year by year we go on cutting the coal away, and at the present time a year's increase in the amount taken is greater than the year's total was not so long ago. Thus the miner is always having to go farther and farther away—perhaps a mile or more—from the opening; and wherever he goes a sufficient supply of air must go with him. The problem is, however, made simpler in one way, because electricity is now very often used for lighting mines, and so, at any rate, the oxygen that would have had to be used up in the burning of any kind of non-electric lamp or candle is saved.

Failure of proper ventilation is very largely responsible for explosions in coal-mines, and possibly, also, for other accidents, through the bad effect of foul air on the mind, the watchfulness, and care of the miners. Since it got to be known how important ventilation is in this respect, the standard has been much improved. An extremely expensive but very thorough way to get good air into coal-mines is to take down liquid air, which occupies very little space, and is rapidly turned into pure air ready for breathing. An arrangement has been made for carrying liquid air down by a rescuer in cases of accidents, where no one could say what kind of atmosphere he might meet in his attempt to save his fellow-workers.

WHY DOES A CLOUD FALL AS RAIN INSTEAD OF IN A LUMP?

It is only quite lately that we have been able to learn the very remarkable answer to this question. We might suppose that, when the air cooled enough, the water-vapor, or some of the water-vapor, in it would be bound to turn liquid all in a mass and then fall "plump." But water cannot behave in this way, because there are certain conditions which must always be present when it turns liquid.

It is necessary that there shall be some solid separate point or particle of something around which the water-vapor can condense when it turns liquid. It seems to matter very little what the thing is, but there must be something, and the consequence is that rain falls in drops. It is the discovery of the cause of the formation of raindrops that enables us to answer this question. The particles that perform this service for the drops may be small or great. Oftenest, perhaps, they are visible specks of dust or dirt, and so on.

We have also discovered that the molecules making up the gases of the air are liable to be broken up in a peculiar way by the action of electricity, and raindrops can form upon these broken-up molecules. We shall not learn much more about the weather until we know more of the electrical happenings in the air.

WHY DOES THE DOCTOR FEEL OUR PULSE WHEN WE ARE ILL?

What we call the pulse is the beating of an artery which lies just over a piece of bone at the wrist, the beating of which is very easily felt. The pulse, felt by a trained finger, gives a great deal of information. In the first place, it tells how often the heart is beating in a minute, and that needs no training to count; but it also tells how strongly the heart is beating, and how regularly. It tells whether the heart is strained or laboring or over-excited, or just beating easily, as it ought to do.

The pulse also tells what is the state of the arteries throughout the body, as to whether the muscles in their walls are tightly contracted or lax; and it also tells—though this requires long training to feel—not merely how forcibly the heart is beating, but how much pressure there is inside the blood-vessels of the body between the heart-beats. This question of blood pressure is enormously important, for it affects the working of every part of the body. The temperature can also be told from the pulse. Thus, of all the single things that a doctor could possibly do, feeling the pulse tells him more than any other; more even, on the whole, than looking at the patient's face; vastly more than taking his temperature or thumping him, or even listening to his heart-beats.

HOW DOES ALCOHOL AFFECT THE BRAIN?

Alcohol belongs to the class of those chemical substances which pass very quickly and easily through any obstacle, such as the wall of a blood-vessel, and so on. Thus, in a very few moments from the time when alcohol is swallowed, it enters the blood, and then is carried in less than a minute to the brain. There it passes out through the walls of the capillaries, or hair-like blood-vessels, and meets the matter of the brain itself.

Careful work is now being done to find out exactly what chemical changes go on when alcohol meets nerve-tissue, and especially nerve-cells. At any rate, it is now clearly proved, quite contrary to what most people used to think, that alcohol stops the action of the nerve-cells which it affects; and the constant rule about its action is that it always first affects the highest nerve-cells, those which are newest in the history of the race; and after them it affects lower types of cells in their order.

Thus, the person may be unconscious, and all the rest of his brain quite thrown out of action, and yet the lowest and oldest part of it, which directs his breathing, may be working perfectly. Various effects of all this are seen in different people, according to the different quality of their brains. The first effect is usually to make the person appear as if he had taken something to render his brain more active, and that is why most people still call alcohol a stimulant.

The explanation of this is that the highest cells of the brain are those whose business it is to control the rest—such as those by which we talk, those that act when we laugh, and so on. Therefore, when the controlling cells and the cells whose business is judgment and keeping guard are thrown out of action, we talk and laugh more freely and quickly and easily.

It is not possible here to say much about how alcohol affects the brain when too much of it is continually taken. It destroys the nerve-cells and causes the overgrowth of the substance that lies between them. This means the eventual destruction of the mind.

WHY DOES A SHADE MOVE TO AND FRO WHEN HUNG OVER THE GAS?

If we could closely watch the air above a lighted gas-jet, we should see that it is continually in rapid motion. Indeed, so powerful is this motion that in some cases a room is better ventilated and has purer air when lit with gas, which keeps the air moving, though it uses the air up, than when it is lit with electricity. Of course, the moving air strikes anything near it, such as a shade, and if the shade is light it will move.

The gases produced by the burning of gas are principally carbonic acid and water in the form of a gas—water-vapor, as it is usually called. These gases, made by burning, are naturally very hot, and so they rise quickly through the colder air in which they find themselves, because that air, being cooler, is heavier. More than this, water-vapor is itself much lighter than air even when it is no hotter, and so that is another reason why the gases from a burning gas-jet rise quickly and disturb anything that is in their way, such as the shade hung over a gas-jet.

It would be quite possible to make these hot gases do work if we balanced some sort of a wheel in their way, just as we place a mill-wheel in the way of a stream of water, and so make that do work. But the particles of gas are much lighter than those of water, and as power depends on speed and weight, there is not really a very large amount of power in their motion.

WHY CANNOT WE BREAK AN EGG IF WE HOLD IT LENGTHWAYS?

It is not exactly true that we cannot break an egg held lengthways, but certainly it is much more difficult to break the shell when we press upon it at the ends. The answer depends upon the shape of the shell. It might partly be that the shell is made thicker at the ends, or it might be that the shell is made of threads or fibers running in a particular direction; but that is not the explanation here.

We may think of the egg-shell as made up of arches. Now, when an arch is narrow and high, it is much stronger, other things being the same, than if it is very wide.

The more upright and narrow an arch is, the more directly does the mass of it resist any pressure from above. In fact, if an arch is narrow enough, it is almost the same as a straight pillar, or column, which directly resists the weight of anything upon it. On the other hand, if the legs of an arch are wide apart, they cannot possibly resist so well, but will be apt to be forced away from each other more easily, and then the arch will break.

Now, we may look upon the egg, when we press it from side to side, as made of two wide, and therefore weak, arches. When we press, we are pressing only against the thickness of the shell, and that resists us little. But when we press the ends, we are met by narrower arches, and we are pressing not so much against the mere thickness of the shell from outside to inside as against the length of it from end to end of the egg.

WHY DOES OIL MAKE A WHEEL GO ROUND MORE EASILY?

It all depends upon where the oil is put. If it be on the ground, then, though the wheel will go round when it is driven, it will not "bite," and we find that the motor-car, for instance, does not go on. But there is a very useful and, indeed, all-important place where oil does make the wheel go round more easily, and also makes it last far longer. That place is the axle, where the wheel turns upon the cross-piece which goes through its center.

Here there is rubbing, or friction, for the wheel turns, and the thing which supports it is still. The friction means that there is wear and tear and the making of heat. These things have to come from somewhere, and they come from the power of the motion of the wheel. This means that the wheel has to move more slowly, for it has lost part of its power of motion.

When we use oil we get a very smooth layer between the wheel and the axle, and that lessens the friction, and so saves the power in the wheel. Nowadays it has been found that if tiny little steel balls are used, and kept properly oiled, they save still more friction, and these ball-bearings, as they are called, are now used in all sorts of machines where it is important for wheels to run smoothly and wear long and well.

If we think of oil as made of a vast number of smooth balls, far too small to see, we shall understand that oil itself makes a kind of ball-bearing.

HOW CAN A NEWSPAPER BE MADE FOR A PENNY?

If only a single copy of a newspaper were to be made, it would cost hundreds of thousands of dollars. If everything required had to be made for the purpose it would cost many millions of dollars in railways, and cables, and ships, and telegraphs, and telephones, and mines for the iron to make the printing presses, and countless things more. It is only because all these things exist already, and serve many other purposes as well, that it is possible to have a newspaper at any price at all.

But even granting that all these things exist, and even realizing that a mere newspaper is really a product and an expression of *all* the greatest facts of civilization, it would still be impossible to produce a single copy of a newspaper for one penny. That would not go far to pay for the printing of it, and to pay all those who send the news and write the articles.

But if a million people or even a few hundred thousands all want the newspaper, then all their pennies together will make it possible to get it. To print one copy of the newspaper may cost hundreds or millions of dollars, according as we reckon all the things it depends upon; but to print two copies will cost *less than one penny* more than to print one, and there is the secret. Merely to strike off copies costs much less than we give for them, and so, if enough of us ask for a thing, we can, by clubbing together, get for one penny what none of us, alone, could afford to pay for if he devoted his life to saving up for it.

WHY DO WE NOT SEE THE STARS EVERY NIGHT?

The stars are shining all the time, sending light to the earth, but more than this is needed for us to see. The light they send must be able to reach our eyes, and reach them distinctly enough. By day the distinctness fails, because the sun is so bright. It has long been believed that, even in the daytime, we can see the stars if we look up at them from the bottom of a deep well. But really this is not true. People believed it without trying for themselves; and when we try we find it is not true. It is true that we can see the stars in the daytime during a total eclipse of the sun.

At night the stars are often hid for other reasons. Clouds will hide them as effectually as if we close our eyelids or draw down our blinds. It is curious to think that rays of light may travel through many millions of miles toward our eyes, and never reach them because of some little obstacle in the last small stage of their journey—a cloud, a blind, an eyelid, or even some opaque thing inside the eye itself.

Fog or mist, like clouds, hide the stars also; but it is well for us to remember that, day or night, whether the sky is clear or obscured by fog or mist or the heaviest clouds, whether our eyes are open or shut, the stars are still shining all the time.

CAN WE MAKE OURSELVES BEAUTIFUL?

There are many kinds of beauty, some that last and some that wear away. We cannot do much for ourselves in the way of the beauty that does not last, for this depends on the chance of our birth and fortune. We can do something, however, by means of living healthy, sensible lives, not eating or drinking too much, taking enough time in fresh air, and keeping the skin clear and the muscles of the face firm by sensible exercise. All this is well worth doing for itself, as well as for its effect upon our appearance.

But there is a deeper kind of beauty which we can indeed make for ourselves if we are wise enough, and to which there will be no end. There is the beauty of a beautiful soul shining through the face like the light streaming through the windows of a house at night. By thinking kind thoughts, by keeping our temper, by persevering firmly in our purposes, we can make our faces a history and register of what our lives have been. All states of feeling affect the expression of the face, and in time the kinds of feeling that we have oftenest had make lines that stay upon our faces, so that children will run to us or run away from us. And so we can make ourselves beautiful or ugly in the only way that matters.

DO CATS AND DOGS EVER CRY?

Cats and dogs may be terribly unhappy—far more than unhappy enough to make them cry if they were human. Yet we know that neither cats nor dogs ever do anything which can fairly be called crying. Of course, they have tear-glands, as we have, because the front of their eyeballs require washing and moistening, just as our eyeballs do; and it may be that their tear-glands produce tears more quickly at one time than at another. But it cannot be said that cats and dogs ever cry.

It would be interesting to study the kinds of animals that come nearest to mankind, and see whether crying is to be found among them. The animals nearest to us are monkeys; and among these there are four kinds, called apes, which are much nearer to us than the others. There is no question at all that they laugh and grin. But no ape cries, and, indeed, we are the only creatures who cry. Why this is so, no one can say.

ARE THERE ANY TWO THINGS EXACTLY ALIKE IN THE WORLD?

This is a question which has often been asked by wise men and which we can perhaps answer at last. If we want to find things that are exactly alike, we must go to what is very simple. We shall never find two men, or even two animals or plants exactly alike. Probably even the very simplest living things are far too complicated in reality for any two to be exactly alike. We must pass away from the world of life if we wish to find complete likeness.

But we have more chance of finding what we seek in the not-living world. Two crystals of any particular substance may be quite alike so far as any of our means of judging can tell us. If we could measure finely enough we should probably find small differences. Far more alike must be the atoms of any particular element, though we have learnt from the study of radium that atoms, even of a given element, may be young or old, and differ accordingly.

We only find perfect likeness, so far as we know, when we come down to the electrons, or "negative corpuscles," that make up all atoms of all kinds. These seem to be all exactly alike in all respects at all times, no matter from what kind of atom they have come.

WHY IS LONDON CALLED LONDON?

Many names of things and places were given long ago, before history began to be written. Therefore we cannot be sure how the names came to be applied to some places. London is one of such names. Its beginnings take us back to the time when the inhabitants of Great Britain were savages. In those days the River Thames was much wider than it is now.

The river made a sort of lake, or lagoon, up which the tide came from the sea. The rude barbarians built a fort, which they called "the fort on the lagoon," using a Celtic word to express that meaning. The Romans, when they came to Great Britain, adopted the word, which they changed a little, so as to fit in with the Latin words that they were in the habit of using. They called it Londinium, and the changes in language since the time of the Romans have modified the word into London. Thus the history of a place may often be revealed by its name.

IS THERE A WORLD BEYOND OUR SENSES?

Nobody who knows anything at all can doubt that there is a world beyond our senses. From the beginning of time men have felt that there were things beyond their dreams, which they can neither see nor hear nor feel. But the nature of that world is part of the mystery of life itself, and of that we know little more than the ancients knew. We speak sometimes as if the ancients were ignorant people, dwelling in barbarism; but, in truth, they were wise in many things beyond the wisdom of our own day.

They measured the earth, they had their ideas about the solar system; even the law of gravitation was not unknown to them. The mystery of life absorbed their attention as it absorbs the attention of our own thinkers; and in this matter they were hardly behind us to-day. And so we are faced with the thought that for over 2,000 years the mind of man has remained almost stationary concerning the great mystery of life. Do we know more about it than the philosophers who lived in Alexandria hundreds of years before Christ, and the philosophers who lived in Athens hundreds of years before Alexandria? Do we understand better than they did the mystery of existence, the great riddle of the universe? Are we able to prove anything more than they knew?

It is a strange thought that the whole human race may have really been standing still for more than two thousand years. So far as ultimate knowledge of life is concerned, we are indeed in exactly the same place as those far-off men of Alexandria and Athens.

But quite recently a hope has come to men that at last we are really beginning to advance. And this hope is founded on the realization that our natural senses are not sufficient for reading the riddle of the universe. The eye, wonderful and exquisite as is its mechanism, is a clumsy vehicle of sight. The microscope reveals to us unsuspected beauty in minute things; the telescope opens to our gaze a flooding glory from immensity. "The native senses," says one American writer, "give us but a slight notion of the real world about us; they are crude, coarse, inaccurate, unreliable, prone to delude."

And so we have reached a time when man has *outgrown his senses.* This is the real miracle of our day. This is the fact, so little realized even by those who insist upon it, which proves that man is immortal. For there is in man something so infinite that it cannot be content with the finite. Man wishes to know, and sets himself to know, more than his body can possibly accomplish. Have you thought what that means? Does it not prove to you that the spirit of man is like a tenant in a house, and that man, every time that he invents a new machine, is really declaring that his house is not big enough for him. His eyes cannot read the stars, so he invents the telescope. His hands are not strong enough to lift iron, so he invents the lever. Everywhere we look, we perceive that science has only advanced where man has called to his aid mechanical inventions for improving his physical powers.

We shall all do well to reflect upon this truth. It is certainly a humbling thought that we know nothing more about the mystery of life than did the ancients of Athens and Alexandria; and it certainly looks as if the mind of man has been standing still for a great space in human history. But let it be grasped by our minds that to-day is the birth of a new era, the beginning of a fresh discovery, and we shall not be depressed by our almost total ignorance.

Man, for the first time in his long and wonderful history, has reached the need for *tools* in investigating mystery. The test-tube of the chemist holds within it secrets which will carry us far on our journey. We have had to outgrow our eyes, our ears, and our hands before we could see, hear, and handle the truth of existence, and no man can say what really lies in the world beyond our senses.

WHY ARE THERE SOME ILLNESSES THAT WE CANNOT GET TWICE?

This is one of the greatest questions in science to-day, and many very clever men are trying to find out the exact reason why we never suffer twice from certain diseases; in other words, how it is possible for people to become *immune,* or free from these ailments. There is no doubt of the fact that when people have had small-pox or measles or scarlet fever once, they very seldom suffer from them again, even if there be an epidemic all round them. In some way or other the tissues of the body have become changed as the result of the first attack, and are thus made better able to resist that particular kind of infection. Some people think that our bodies have become accustomed to that infection, so that it does not infect them any more; but, whatever the exact nature of the resisting power is, there is no doubt that it is a very common process in many parts of our nature.

WHY CAN WE HEAR SO MUCH BETTER OVER WATER THAN OVER LAND?

Sound is composed of waves of different lengths transmitted through the air, and these waves can be interrupted and broken up by coming in contact with any obstacle, as the waves of water are broken up when they strike a rock. Now, on the land sound waves cannot travel very far without striking against houses, or trees, or mountains, or other obstacles to their progress, and these prevent the sound traveling to a great distance. On the sea, however, or on a great lake where the surface is perfectly level, it is possible to hear for a very long distance, simply because there is no hindrance to the path taken by the sound.

WHY DO WE SWING OUR ARMS WHEN WE WALK?

It is rather difficult to say exactly why we swing our arms when walking, but there is no doubt that it is much easier to walk in comfort if the arms are allowed to swing naturally than if they are held stiffly by the sides of the body. Probably, therefore, the swing of the arms assists us in unconsciously keeping accurate balance as we move along, first on one foot and then on the other. Perhaps, too, it may be partly a relic of the time when primitive animals used their arms as well as their legs in walking, as a chimpanzee will do. In any case, the fact that it is so much more comfortable to walk swinging the arms seems to suggest that Nature may have intended the swinging to help us in accurate movement.

WHAT MAKES SOME PEOPLE DUMB?

As a rule the cause of dumbness has nothing to do with the vocal chords at all, which are always present and apparently normal, but for some reason or other in these people who are dumb the vocal chords cannot be used. That is to say, although the brain may produce an idea, and the person may wish to speak, something has happened which prevents the message being sent from the brain to the vocal chords, and so there is no speech. So that we may say that any disease or injury which destroys that part of the brain called the "speech center," or any disease or injury to the nerve fibers which pass from the speech centers to the vocal chords, will cause dumbness. Dumbness is sometimes present from birth, owing to some defect in development; at other times it comes on suddenly in after life. Sometimes it is permanent, at other times it only lasts for a short period and the person may recover the power of speech.

WHY DO LOUD NOISES MAKE US DEAF FOR A WHILE?

This is partly because a very loud noise makes such a very strong and powerful impression at the time that no other impression of the nature of a sound can be appreciated until the first one has disappeared. It is just the same with other sensations. We cannot feel more than one very intense sensation at once, and the attention of the mind is given to the most powerful. The deafness following a loud noise, or a box on the ears, is also partly due to the changes in the position of the drum of the ear and the delicate internal parts which take a little while to return to their natural position, because until they do this no other sounds can be properly appreciated.

WHY DOES THE CHAMELEON CHANGE ITS COLOR?

The object of the change of color of the skin of the chameleon is to enable it to become like its surroundings at the time, and so aid it in concealing itself. This capacity the chameleon shares with many other lizards, and they are able to change because they possess within the skin a great number of small cells closely packed together, filled with small granules. This causes a white color by reflecting light. Other cells are full of oil drops and appear yellow; others contain brown or reddish pigment, and the changes in color are brought about by contraction of different parts of the skin, and the movement of the different pigments. Thus, when all the pigment is forced toward the surface the animal looks quite dark. When the pigment is not so near the surface the color is changed to green, and where there is no pigment the skin appears yellow. The mechanism which causes these changes appears to be under the control of the will of the chamelon, but, in addition, the external surroundings, such as heat and cold, also cause some changes in the color.

WHY DOES VACCINATION KEEP US FROM HAVING SMALL-POX?

There are some diseases from which a person never suffers twice, because the first attack makes the sufferer immune, or proof against a second attack of the particular microbes that cause this illness. Small-pox is one of the diseases against which we can be so protected. But many years ago a famous man named Jenner discovered that it was not necessary to have the actual disease in order to become protected, but that it was sufficient to produce a very slight illness by vaccination. The effect of this was found to be such that people who were properly vaccinated were quite free from the infection of small-pox for some years, generally five years at least. After that the effect is apt to wear off; and so in some countries it is the custom to be vaccinated every five years.

WHAT MAKES A WATER-SPOUT?

Just as the waves of the sea are due to movements of the air, so the very astonishing disturbance of the sea called a water-spout is also due to an unusual disturbance of the air. Sometimes parts of the air get started in a twisting motion, rushing through the air and at the same time turning round and round very quickly, somewhat as the earth rushes through space and turns round all the time. When this happens the sea may be very violently disturbed; and sometimes in the middle of this twisting portion of air there is very little air indeed—it is almost like a hollow twisting column of air. Then the water just beneath may be suddenly sucked up so as to fill the almost empty space inside this twisting column of air, and that makes a water-spout.

WHY DOES A FALLING OBJECT TURN ROUND?

The answer to this is that a falling thing turns round only if a turning motion was imparted to it when it began to fall. If we dropped a ball in such a perfectly even way that every part of it was let go at exactly the same moment —though this is by no means an easy thing to do—then it would not turn around as it fell.

But it happens that almost always, when anything is let fall, it is not let go quite evenly, and so a turning motion is given to it, just as it is given to a rifle bullet, and it goes on turning. Even when this does not happen, an object may be so shaped that one part of it offers more resistance to the air than another. That part will be retarded as the object falls, and so it will acquire a turning motion. This turning affects the flight of anything through the air, and if it be a ball affects it the way it bounces. So that in hitting a tennis-ball, or bowling a cricket-ball, we try to "put a twist on it," and this may make it swerve in a curious line as it twists against the pressure of the air.

WHY DOES WATER RUN?

The power which holds things together is called *cohesion*—a word which simply means *sticking together*. We cannot see what really happens, but cohesion is one of the commonest things in the world. When you move one end of a stick, why does the other end move? Because of cohesion between all the parts of which the stick is made. All the parts of the stick hold together as if drawn to each other by a magnet.

Cohesion is one of the most important things in the world, and the world itself, indeed, could not exist as it is without cohesion. Everything that we call solid is solid because the tiny parts of which it is made stick or hold together. Water runs because it has no cohesion, or very little. Running water is liquid. While all solids have a great deal of cohesion—without which they could not be solids—liquids have very much less. But all liquids are by no means the same. Liquid water has very much less cohesion than liquid sealing-wax or liquid gum, which, indeed, has so much cohesion, or sticking together, that we appropriately call it "sticky." On the other hand, liquid alcohol or liquid air—did you know that air could be liquid like water?—has very much less cohesion even than liquid water. But there is a third state in which anything may be, and that is the state of a gas—like air in its ordinary state, like the water which comes out of our noses when we breathe, and like the gas we burn for light. Now, *the* thing which marks a gas is that it has no cohesion at all—it runs wherever it can. However big the space that it is in, the gas always fills it. It goes under doors, out at chimneys, and out at windows, and so on. It has no cohesion.

WHAT WERE THE FIRST BUILDINGS LIKE?

The first things men ever lived in were not buildings at all; they were just holes or caves in the earth. We have found some of these caves with bones and teeth and other things which tell us what these men had for dinner long ago. The first attempt that man made to build, I think, was simply to make the caves that he found rather bigger and more convenient; and so he scooped them out and made them deeper, and often he scooped away much of the roof so as to make the cave higher, and let him stand and walk upright in it. And when at last man began to build for himself, he made huts, such as many men live in even nowadays, like the Eskimos. And these huts are really very like caves if you come to think of it. Like caves, they have only one story and only one room, and no chimney. Men were a long time in rising from the use of these early huts to such cathedrals as those of Milan and St. Mark's.

WHAT WAS THE FIRST GREAT BUILDING?

In time man learnt to use stone, and even to make artificial pieces of stone which we call bricks, and, of course, with these he could make fine buildings; and some of these, though they were built thousands of years ago, and are far older than the great cathedrals, and not less beautiful.

Every one agrees which is the finest building ever made before the time of Rome, and before civilization reached Italy. This is called the Parthenon, and, indeed, so far as beauty is concerned, it still is the finest building in the world, though far from being the most wonderful as a building. The Parthenon was built about 500 years before the birth of Christ, in the greatest age of Greece. It was built entirely of white marble, and the figures of horses and men that ran around it outside were made by Phidias, the greatest sculptor who ever lived. Many of these were moved away by Lord Elgin, and may be seen in the British Museum, where they are known as the Elgin Marbles. There is also a very perfect model of what the Parthenon was like when it was built.

WHO INVENTED ARCHES FOR BUILDINGS?

One of the remarkable things about the great buildings of Greece is that they do not have arches. Buildings, indeed, were in principle the same as you can make with toy bricks. Now, it is a curious thing that somehow or other, though the Greeks learnt so much from the Egyptians as regards science and art and many other things, they did not know about the arch. Yet, even in very early Egyptian buildings, we find various kinds of arches, including even the pointed arch which you must have seen in many churches. Now, I wonder whether you have heard the word "Keystone"? There are two kinds of arches—one built as a half circle: and the other is very interesting, for it is built up from the two sides, and then at the very top of the arch there is put in, last, a stone called the keystone, because it keys, or, rather, locks, the two sides of the arch together. People who study buildings say that the kind of arch they call Gothic does not have a keystone, the two sides meeting in a straight up and down line.

WHO WERE THE BEST BUILDERS?

Now, you know that the Romans came after the Greeks, and that nearly everything they knew and could do they learnt from the Greeks. Indeed, I am afraid that there was a great deal which the Greeks knew and the Romans forgot. Now, the Romans did not build so beautifully as the Greeks. There never was any building in Rome so lovely as the Parthenon. But one thing the Romans had which the Greeks had not, and that was the arch. I do not think any one knows whether some Roman found out all by himself how to make an arch, or whether they found arches in Egypt, or somewhere else; but, at any rate, somehow or other the Romans had the secret of the arch, and they seem to have been very proud of it, and used it whenever they could.

They were very fond of building what they called triumphal arches in honor of some great soldier or some great event, and you will see such arches in Rome and many parts of Italy. The Washington Arch in New York is the same sort of thing.

In our own times we have made a great discovery as regards buildings. You know that instead of building ships of wood we build them of iron and steel. Well, we do the same thing now in building; instead of stone we use steel.

WHAT IS THE SKELETON OF A HOUSE?

THE skeleton of a house is the real framework underneath the outer covering which we see. Really we are waiting for some very clever man with an original mind who will be able to make a modern steel building without having to face it with stone and pretend that it is made of stone. Of course, any one could do this, only the building would look so ugly. We have not yet learnt how to treat the steel so as to make it look beautiful. I am sorry I cannot tell you how to do this. If I could, I should be the genius we are all waiting for. But he will come; and if we do not yet know how to make steel buildings that are both beautiful and useful, it was, after all, just the same when men began to use stones and bricks.

WHY ARE THE RAINDROPS ROUND?

I THINK that really you should have first asked, Why does the rain form drops at all? We know now that there is always something which we may call a speck of solid stuff in the inside of a raindrop, and when the drop was made it was made by the water-gas or water-vapor in the air turning liquid upon this solid speck, as steam from boiling water turns liquid on a cold plate held above it.

But you want to know not merely why the raindrop forms at all, but also why, when it is formed, it is so nearly round. The answer is the same as the answer to the question why water forms in round drops on a plate, and the question why it runs in drops down the window-pane when it rains. When water turns liquid it really consists of a kind of crowd of tiny parts, each of which is itself a part, or particle, as we say, of water, just as a human crowd is made of men and women.

Now, these little particles of water behave rather as a crowd might behave, if all the men and women making it were to catch hold of each other's hands, so that they were all joined together. If they all held on to each other as tightly as they could, and especially if all the people on the outside of the crowd held each other's hands so as to make a ring, then that crowd would be something like the crowd of particles of water that make up a drop of water. They all prefer to hold on to each other, and stick together, and that is why the drop is formed at all.

HOW DOES THE PIANO PLAY?

THE simplest way of understanding all this is really to take a piece of string and stretch it tight at its two ends. This piece of string is just like the wire inside a piano, which you hit when you strike a note; and the wire is stretched just as the string is stretched. When the piano-tuner comes, he goes over all the wires inside the piano to see that they are stretched just as much as they ought to be. Well, now, if you take this string and twang it, you can *see* it moving backward and forward, and can hear a low sound. When anything moves backward and forward like this, we say that it is *vibrating*, which simply means *trembling*. Every time it moves it makes a little wave in the air. If you make the string shorter, or if you stretch it tighter, it vibrates more quickly, and the musical note it gives out is a higher note, more like the treble of the piano. When we speak or sing, we make two cords in our throats, called the vocal cords, vibrate, or tremble, just like this cord or string that we can see vibrate for ourselves.

DO WE SEE WHAT IS NOT THERE?

BESIDES not seeing most of what is "there," our eyes often see—or think they see—what is *not there*. Some of the most remarkable events in history have been due to mistakes of this kind. Animals also make these mistakes; but you know that one of the great differences between us and the animals is that we have *reason*. One of the great duties of the reason is to judge of what the senses, like eyes and ears, tell us, so that we shall not be deceived, or so that we shall *learn all the more* from our mistakes.

Too many people, however, let their reason rust, and are at the mercy of whatever their senses report to them, without being able to judge and distinguish between mere appearances and what is real. It is less trouble just to take things "at their surface value," as we say, than to ask questions and try to pierce to the heart of them. That is the reason why so many people stop thinking, and why there are so few "thinking people," or people who use their reason—as we are meant to do.

CAN WE SEE EVERYTHING?

I THINK we may almost say that there are just two sorts of people in the world—the foolish, who think they see all there is to see, and the wise, who know that they don't. This applies to seeing with the eyes of our heads, and to seeing with the eyes of our minds—which you mean when some one explains something to you, and you say: "Oh, I *see* now!"

One of the greatest and wisest men who ever lived said that the highest knowledge a man could have was to know that he knew nothing—nothing, that is, compared with all that there is to know. For this, and other great sayings, this wisest of men—his name was Socrates—was murdered by his fellow-citizens over 2,000 years ago.

Even with actual seeing, and the best and brightest eyes, we see only a little of what is there, and usually see only its surface. That is why *insight* is such a good word for wisdom: it means that the eyes of a man's mind *see into* a thing. Then our eyes only see certain kinds of light. There are other kinds, *which are darkness to us*, yet we know that they can be seen by the eyes of ants, and also they can be seen by the lifeless eye of the camera, which has seen for us hundreds of thousands of stars that our eyes have never seen, and never can see.

WHAT IS THE CINEMATOGRAPH?

CINEMATOGRAPH simply means "moving picture." You take a camera, and run through a number of films one after the other, perhaps at the rate of forty or so in a second. Perhaps the camera is looking at the sea, or at some great procession, or at a game of football. Then, if you take a magic-lantern, and run the film through it at the same rate as you ran it through the camera in the first place, you can throw a moving picture upon a screen. The eye remembers each separate picture after it has gone just long enough to blend it in your brain—where your real eyes are, at the back of your head—with the next picture that comes along; and so you see the waves or the procession as if you were looking at the real thing. That is the way in which the cinematograph makes pictures live.

WHAT ARE SOME OF THE USES OF THE CINEMATOGRAPH?

WISE people are teaching us by the cinematograph. For instance, students can learn how a great surgeon performs an operation a thousand miles away by seeing a living picture of him at work. And men have taken living pictures of wild birds flying home to their nests over the water, the parent birds feeding their young ones, the young ones learning to fly, and so on. And the cinematograph is now being used in the schools in some parts of the country in teaching geography and history, and will be still more extensively used at a later date. Yet other men have made living pictures of the blood running through the little tubes in the web of a frog's foot, so that thousands of people at once can see with their own eyes what the circulation of the blood is, and how the little blood-cells tumble over each other as they scurry through these tubes, carrying oxygen from the frog's lungs to every part of its body—just as our blood does for us. Before very long, I believe, the cinematograph will be used all over the world for teaching, as the blackboard is to-day!

WHY DO SPINNING LIGHTS MAKE RINGS?

WHEN black and white have an equal chance, the white conquers the black, because the white is *something* and the black is *nothing;* black is simply *no light.*

Some of you have seen an interesting black and white top which shows exactly what happens when you spin a light round, as boys do often, to make a circle of fire. The disk of this top looks all white when you spin it under a bright light, because your eye remembers the white when the black comes round, and remembers it till the white comes round again! And the black lines make black circles because they catch the eye and the eye remembers them in the same way. It is the eye's way to see a thing for about one-fortieth part of a second after it has gone! If you spun the disk in the dark as fast as ever you pleased, and then had a sudden light that came and went very quickly, you would see the spinning disk exactly as if it were still—half white, half black, and with bits of circles instead of whole ones. In some lights, too, we see colors, probably because the eye gets confused and invents them.

I have seen a whole roomful of people astonished at this experiment. The eye sees what is really there, and then the light goes out, and so, though the eye goes on seeing for a little after the light goes, it gets no chance to have another look. This proves that nothing happens at all to the disk to make the change when it is spun. It is the way the eye sees that deceives us. The eye does the same with colors when they are spun, as we may see in the color-disk which illustrates the same principle. The eye goes on seeing one color even when another has come; it mixes them and then we see a new color made of the mixture!

ARE THERE TWO DAYS AT ONCE?

Since people live in different parts of the world, what we call night (when it is our night) will be some one else's day, and our midnight, when a new day begins for us, as we reckon, will not be the midnight of other people in other parts of the world, so that what we *call* Monday they may *call* Tuesday, yet we and they are both talking about the same moment!

Now, it would be very inconvenient if all the different parts of the world east or west of each other persisted in talking of time as if they were the only people on the earth, and as if their midnight must be everybody's midnight—which it is not. So we reckon by two sorts of time. One is *local* time—the time reckoned by what is happening at the particular place whose time it is; the other is *standard* time, which we agree upon, so that we can catch trains, and so on, just as if midnight in one place were midnight everywhere. Up till 1883 people often missed trains through this difficulty, and then "standard time" was invented.

WHAT MAKES THE WATER BOIL?

We cannot answer this question until we know what it is that forms the bubbles when water boils. They are bubbles of water. If you hold a cold plate over boiling water you will find drops of wet water form upon it, though you can see no water passing upward between the surface of the boiling water and the plate.

The truth is that, though we always think of water as something liquid and wet, just as we think of air as something that is always a gas, we have no right to do so. Air and water, and everything else, can exist in three different forms, either *solid*, or *liquid*, or in the form of a *gas*. Air, for instance, is usually a gas, but it is not very difficult to make air liquid, so that it looks just like water, or to make it solid, so that it looks just like ice. Water happens to be usually fluid, but we all know that when it is cold it becomes solid, ice being simply solid water; and we must now learn that, when it is hot enough, water becomes a gas just like air. Indeed, the air contains a quantity of water-gas, or water-vapor, as it is usually called, and when we find the weather close and "muggy," as we say, it is usually because there is more of this water-vapor in the air than we like. When water boils, then, the bubbles are bubbles of water-gas or water-vapor, and if this vapor strikes a cold surface like a cold plate, it becomes liquid or wet again.

One of the things that decides whether anything shall be solid or liquid, or a gas, is heat; and so, of course, the simple answer to the question, "What makes the water boil?" is *heat*. We apply heat to water, and it begins to turn into gas, which makes the bubbles.

WHERE DOES WATER BOIL AWAY TO?

If we go on boiling the water, of course we boil it all away as gas, until there is none left. In an ordinary way water always begins to boil when it is at a certain *temperature*, or "hotness," and this is called the boiling-point of water. It is not possible in an ordinary way to have wet water any hotter than this point, no matter how much heat you apply to it. The result will be not to make it any hotter, but simply to turn it into gas until it is all gone.

I said "in an ordinary way," because it is not difficult to make water boil without being nearly as hot as boiling water usually is. One of the things that decides the boiling-point is the pressure of the air, at the bottom of which we live. Now, if you take some water up to the top of a high mountain, the pressure of air is much less, because there is not so much air above you. If now you heat the water, it begins to boil when it is nothing like so hot as it needs to be made before it will boil at the bottom of the mountain: because on the mountain there is less pressure of air squeezing the water, and so it can more easily expand into bubbles of gas. So if you put an egg in the water at the top of this mountain, you may boil and boil as long as you please, but you will never boil the egg hard, simply because, however long you boil, you can never make the water hot enough to make the egg hard. The water simply floats away as gas long before you can do so, and you must eat your egg nearly raw, though it may have been in boiling water for an hour! You might almost drink boiling water if you were on a very high mountain.

WHERE DOES THE DAY BEGIN?

The sun goes on shining *all the time*, you know—it is well to remember that "the sun is always shining somewhere"—and the earth is spinning all the time. So the sun is always seeming to rise somewhere, because at some place or other the earth is just spinning round, so as to face it, and the sun is always seeming to set somewhere, because at some place or other the earth is just spinning away from the sun. That is simple.

And, of course, whatever we call *now*, whether we call it six o'clock or twelve-o'clock, *this now is now everywhere*. The present moment *is* the present moment here and on the farthest star. Only when just opposite the sun *we* call that midday, whereas the people on the other side of the world are then away from the sun, and call it midnight; but this present moment of ours is their present, too, of course, and the difference is merely a difference of name to indicate that *now* we are opposite the sun, and they are away from it.

But, simply because the earth goes on spinning, and the sun is always shining, the day is dawning somewhere always, so that for answer to our question we may quote a verse from Longfellow:

" 'Tis always morning somewhere.
And above the awakening continents,
From shore to shore,
Somewhere the birds are singing evermore."

WHY DOES A WHEEL GO ROUND?

A WHEEL goes round for the same reason as the earth or a top. Nothing goes round or moves of itself, but it always requires some force from somewhere to move it. If it is a bicycle wheel that goes round, it is the force of the muscles of your leg that makes it do so, or if it is a carriage wheel, the force is produced in the muscles of the horse; but if once anything is started spinning—as the earth, or a top, or a wheel—it will go on spinning until something stops it. In the case of your bicycle, when you stop pedaling, the wheels gradually move more slowly if you are going on the level, because the resistance of the air slows you down, exactly as the resistance of the water slows a boat down when you stop rowing. But you know that if you are going downhill you will not stop, but may actually get faster and faster. This is because, though the air is resisting your bicycle, the attractive power of the earth, which we call gravitation, is pulling on the bicycle, and it pulls more strongly than the air holds you back.

But wheels also stop through another kind of resistance, which is called *friction*. The wheel of a bicycle, for instance, travels round and round on something in the center of it, which we call the axle, and as the wheel rubs against the axle it is made to go slower. If you put your finger on your arm and rub it along your skin and press a little, you can see how you are opposed by friction; but if you put some oil on the tip of your finger first, the finger will slide along your arm quite easily, because the oil lessens the friction.

For exactly the same reason you have to oil the bearings of a bicycle. Perhaps you know that a special way has been found in which to lessen the friction of a bicycle, so that, after you stop pedaling, the wheels will go on running much farther than they otherwise would. A number of tiny steel balls are put between the axle and the wheel, so that the wheel really runs on these little balls. This is what is called "ball bearings," and every bicycle has them, both for the wheels and for the pedals.

WHERE DOES THE HOUR CHANGE?

Now let us see what this means. You understand that, as the earth spins toward the east, the only places at which the dawn comes at the same minute are those on a line drawn from the North to the South Pole. When one of our readers in Boston is up and eating his breakfast, it is still dark in Denver, since the earth has not turned far enough for the rays of the sun to reach that city. When the schools in New York are dismissing for luncheon at noon, the pupils in San Francisco are just going into school.

In order to prevent confusion, lines have been drawn across the United States from North to South, dividing the country into four "time belts" or zones. People in the east have Eastern Time; then comes Central Time, Mountain Time and Pacific Time. In each of these zones, the clock is an hour slower than it was in the one before, so that when it is nine o'clock in Washington, it is eight in Chicago, seven in Denver and six in Seattle.

If one kept on traveling westward, the sun would rise later and later every day, and when he had gotten all the way around the world, he would have lost a whole day. If he traveled eastward the condition would be reversed.

WHY DO WE HAVE NAMES?

WE have names for the same reason that everything has a name. If we did not have names, we should have to have numbers, like the numbers on motor-cars, which serve just the same purpose. Now, there are names which have meanings, and there are names which have none, and it is always well to know how much and how little a name means. There is something which we call electricity, which means really that it has something to do with amber, for when you rub amber you get electricity, but people sometimes speak as if the name explained electricity, or as if it explained something else to say that it was electricity. That is because they do not know how little the name means. We might just as well call electricity X—which is the name in what is called algebra for something we do not know.

One thing you ought to know, however, is the meaning of your own name. If your name is Theodore, for instance, you ought to know that that means the gift of God. Many of our names have meanings, which you can sometimes find in the Bible. The Bible tells you, for instance, what Peter means, but you must find out for yourself where it is.

COULD A TOP SPIN FOREVER?

Friction also helps to stop a top, but if you spin the top on a perfectly smooth plate, so that there is very little friction, it will spin much longer; and if you could spin the top on a smooth plate inside something from which you had taken away all the air, it would not be difficult to get the top to spin for hours, because *things which have once started moving go on moving until something stops them*. If the top could be spun where there is no air at all, and nothing happened to hinder the spinning, the top would certainly go on forever. The earth is like a great wheel or top spinning round and round in space, but, as space is almost empty, and as the earth's air is part of the earth and goes round with it, and as the earth is not spinning on anything, as a top spins on a plate, the earth scarcely slows down at all throughout the ages.

HOW FAST CAN A WHEEL GO ROUND?

Now, you might think that if you applied sufficient force to a wheel—say, the wheel of some kind of engine that was driving something—it would go round faster and faster and faster, and there need be no limit at all to the speed at which it went round. But that is not true, and sometimes when men forget it, and make wheels go round too fast, terrible accidents happen. If you take an umbrella that has been out in the rain, and twirl it round very gently and slowly, the drops of rain will hold on to the umbrella tight enough to go round with it, but directly you spin the umbrella a little faster, the drops of rain, as you know, fly off from the umbrella. As long as the umbrella went round slowly, the force of sticking, or *cohesion*, as it is called, was sufficient to make the drops stick to the umbrella, but when the umbrella went round a little faster, the force of cohesion could not keep the drops sticking to the umbrella, and so off they flow. But now, after all, it is nothing but cohesion that makes the parts of a wheel stick to each other, and if the wheel went round quickly enough, this cohesion would not be strong enough to hold the wheel together, any more than it is strong enough to hold the drops to the umbrella if spun quickly.

WHY DOES A STICK FLOAT?

We must remember that the earth is all the time trying to pull everything to itself; it pulls us, it pulls the air, it pulls a balloon, it pulls the moon. Now, the heavier the thing is the more it is pulled, and water is heavier than a stick. This does not mean that all the water in a pond is heavier than a stick, because, of course, we know that. But it means that, if you had a cup and filled it with water, and had another cup the same size and filled it with stick, the cup with the water would be heavier—that is to say, *in a fixed amount of space you can pack a greater weight of water than of wood.* That is what we mean when we say that the water is heavier than the stick.

Of course, a pound of water is the same as a pound of stick, and you do not need me to answer the question—Which is the heavier, a pound of feathers or a pound of lead? They both weigh the same, only the lead takes up less room, and so we say that lead is heavier than feathers, though a pound of lead weighs the same as a pound of feathers. The proper name for a heavy thing is *dense,* and, whenever it is possible, the earth always pulls the denser things farthest down, and the less dense things float on the top of it. That is why the stick floats; that is why the cold air is found nearest the floor, because cold air is heavier, or denser, than warm air, and the warm air floats on the top of it as the stick floats on water.

COULD A WHEEL FLY TO PIECES?

Sometimes when an engine has been set running too quickly, a great wheel, perhaps made of heavy steel, has flown to pieces. These pieces have gone flying out just as the drops do from a spun umbrella, and sometimes these have done terrible damage. This applies to everything that spins—the earth, or a wheel, or a top. There is a limit to the speed at which it can spin without flying to pieces, because there is a limit to the power of cohesion, or holding together, and directly that limit is passed, the pieces of the wheel, or the top, or the earth—if the earth were set spinning too quickly—must fly away. For everything that is moving tries to move in a straight line, and the reason why a wheel can spin at all is that the parts of it move in circles instead of in straight lines, because they are held by cohesion; but if cohesion is not strong enough, all parts of the wheel, like the drops on the umbrella, will start moving in straight lines instead of in circles, and the wheel will fly to pieces.

WHY DOES AN IRON SHIP FLOAT?

Men used to think that a ship had to be made of wood in order to float, because wood floats and iron sinks. But now all big ships are built of iron. Why do they not sink like a stone or an anvil? It is because of their shape. When they are hollowed out the whole space they occupy is filled with air, which makes the ship, as a whole, lighter than water, and so it floats. You can even put things into it, but the more you put in, the deeper your ship rides in the water. You can store iron in it, but if you packed it full of iron, or anything heavier than water, it would sink.

One brave man fought for years for the lives of sailors, and at last got a law made that a line should be painted outside the hulls of ships, and that the ships must not be packed so heavily as to sink that line below the surface of the water. Like every one who does anything worth doing, he was laughed at, but his name will always be remembered, and that line, which protects sailors, will always be called Plimsoll's line, in his memory.

WHAT IS THE DIFFERENCE BETWEEN DISCORD AND HARMONY?

To a certain extent, harmony is a matter of taste and custom. Modern musicians play chords which strike us as quite harmonious, though we know that our ancestors thought them intolerable. But there must always remain a very real difference between harmony and discord, and we find, when we study it, that it is due to the *proportions* between the various notes that are sounded together. A musical note depends upon sound-waves of a certain rate, say, 800 little waves in a second. Now, the notes that are most harmonious with this are those in which the waves bear a very simple proportion, in their number, to 800. A note made by 1,600 vibrations in each second is, indeed, so harmonious that we do not call the two a harmony at all, for the higher note, the one with twice as many vibrations, is simply the octave of the other.

Similarly, a note of 400 vibrations in each second is the octave below. If we take the common chord which every one knows so well, such as C, E, G, C, on the piano, which every one finds perfectly harmonious and satisfying, we find a proportion between the vibration numbers of the notes which is correspondingly simple. If the high C were 800, the lower one would be 400, the E 500, and the G 600. In other words, the proportion of the notes in the common chord is simply 4, 5, 6, 8. This simple proportion between the notes is the basis of harmony, and the absence of it is the basis of discord. *Why* our ears should find the one pleasant and the other painful is a question too difficult for us to answer.

IS THERE RADIUM IN THE SEA?

This wonderful element, radium, which at first was thought to be one of the rarest of all things, is now found to occur simply everywhere, and to be of the utmost importance wherever it occurs. We find radium in the waters of rivers, and we find still more of it in the ocean wherever we look for it. It is clear that the radium, or rather the element *uranium*, from which radium is always being formed, accumulates slowly in the ocean as the rivers bear it there, just as do the salts which the rivers carry. At one time there must have been much less radium than now in the sea, just as there must have been much less salt. Also, we find a considerable quantity of radium in the present deposits at the bottom of the sea, and in past deposits, such as chalk, for example. The total amount of radium in the deposits, or "oozes," at the bottom of all the oceans must be very large, and its consequences, both there and in the sea-water itself, are most important, because, wherever radium is, there it is constantly producing heat. We are just beginning to learn that this presence of radium in the sea and the sea's deposits must have played a part perhaps greater than any other one thing in the history of the changes which the surface of the earth has undergone.

WHERE DOES CHALK COME FROM?

The chalk found in cliffs on the south coast of England and the chalk used on a blackboard or for drawing with are the pressed-together remains of the bodies of tiny creatures that once lived in the sea. The rest of their bodies has disappeared ages ago, but the carbonate of lime, which is chalk, has not been altered through all these years. As they died, it fell to the bottom of the sea, and was piled up there, often to very great thicknesses, as we could see for ourselves if we looked at a high chalk cliff.

This went on for many thousands of years, no doubt, but, compared with the deposits of many of the rocks formed at the bottom of the sea, the chalk deposit was quite a quick one. This means, of course, that the cliffs at such a place as Dover were once at the bottom of the sea. If you walk in many parts of England, such as Kent and Sussex, and find that you have only to scratch the soil to find chalk underneath, or if you pass in a train through a chalk cutting, you may reflect that all this was once at the bottom of the sea.

DOES A BRIDGE SHRINK IN THE SUN?

CERTAINLY not. On the contrary, a bridge expands, or gets larger, in the sun or in the daytime or in the summer, and shrinks, or contracts, in the shade or at night or in winter. The rule is that heat makes everything expand, while cold makes everything shrink. Cold is not a thing, but the absence of heat; and so we may say that everything occupies more or less space according to the amount of heat in it—that is, of course, if other circumstances, such as the pressure round the thing, are kept the same. Metals have a striking way of changing their volume, or size, under the influence of heat, and so this change is very noticeable in the case of iron or steel bridges such as are built nowadays. If the engineer does not know that bridges expand in the sun, he will build a bridge that is certain soon to get strained, and even to crack. He has to reckon on the amount of expansion that will occur under the influence of such heat as the bridge is likely to be exposed to, and he must allow for it. In a bridge like the Brooklyn Bridge, many inches have to be allowed for its change of size according to its temperature

WHY DO OUR HEARTS BEAT FASTER WHEN WE RUN?

WHEN we run we are doing work, for we are moving a certain amount of matter—our bodies—at a certain speed through space. The power we spend has to come from somewhere, and, indeed, what happens is that large quantities of sugar and other things are quickly burned up in our muscles.

The result of their burning is the gas called carbonic acid, which is a poison to all animals and human beings. The blood becomes quickly filled with far more of this gas than usual, and means must be adopted to get rid of it quickly enough, or we should die of poisoning by this product of our own lives.

If we examine the air coming from the lungs of a man who is running or doing hard work with his muscles, we find that there is, perhaps, ten times as much carbonic acid in the breath he breathes out as there is when he is at rest. It is quite evident that the first thing the body must do in such a case as this is to make the blood move as quickly as possible, both through the muscles and the lungs.

It must move quickly through the muscles, because they are using up a lot of oxygen, and because they are making a lot of carbonic acid. The quick supply of blood is making a quick supply of air, and the extra beating of the heart is really very like the beating, as it might be called, of a pair of bellows when we want to drive an exceptionally quick supply of air into a fire. Also the blood must pass quickly through the lungs so as to get a lot of oxygen and lose its excess of carbonic acid. Therefore, the heart beats quickly.

It has lately been found that when a man is "in training," as we say, he produces much less carbonic acid when he runs than when he is not trained; and his pulse is not so much quickened. Thus, being in good condition means, among other things, that the body learns to be more economical in its consumption of fuel than it used to be.

DOES RAIN MELT THE ROCKS?

THERE are two things in rain, besides the water itself, that have a great power of melting things; and even the very hardest rocks, such as granite, which look as if no amount of rain could affect them, are melted down by it in time. These two things are called *nitric acid* and *carbonic acid.* We know the history of carbonic acid, and the nitric acid has been produced by the union of the oxygen and nitrogen in the air when electricity is discharged through it, as it is during a thunderstorm.

These acids eat away the rocks, and the weaker acid — carbonic acid — is probably the more important in this respect. It gradually melts the hard granite on which the rain falls, and so transforms it, first into sandstone, and then into sand. This process goes on very slowly, but it goes on very certainly; and in both of these respects it is like the greater number of Nature's most important processes. The two acids in rain are still more important in their relation to life; the carbonic acid, as we already know, and the nitric acid are part of the food upon which the plant lives.

WHY DO WE SOMETIMES GET A "STITCH" IN THE SIDE WHEN WE RUN?

When we run we require a quick renewal of the oxygen in our blood, as we are using it up very quickly in our muscles. Therefore we have to breathe quickly and deeply, and this we do especially by means of the great breathing muscle called the diaphragm. This muscle, though strong and broad, is rather delicate at certain points. It is attached to the inner surfaces of each of the six lower ribs, on each side of the body, by rather fine slips of fiber. These same ribs are also moved by muscles that lie between each two of them; and the explanation of a "stitch" probably is that, as the ribs move rapidly and rather forcibly when we breathe quickly and deeply, sometimes one of the attachments of the diaphragm gets a little strained, and that causes the pain we feel.

We think of a stitch as a bad thing, but that is wrong. It is a good thing, for it is the warning that prevents us from doing serious harm to the slightly strained fibers. They get a rest, and probably when we start again we so arrange as not to throw quite so much work upon them. The practiced runner does not get a stitch because, by practice, he has learned to use all his breathing muscles, though unusually hard, yet in a nicely balanced and even way, so that no part of them is strained.

WHY DOES THE TRUMPET ON A PHONOGRAPH MAKE THE SOUND LOUDER?

We may ask this same question in many forms. For instance, why does a sounding-board over a pulpit make the preacher's voice louder? Why does opening the lid of a grand piano make the sound louder, especially on the side that the open lid is facing? Why does a singer's voice sound louder when he keeps his tongue low in the floor of his mouth?

In all these cases we see the same principle at work, and similar instances might be quoted from the case of light, as when we place a concave mirror behind the light in a magic-lantern, or have a complicated arrangement of mirrors behind the lamp of a lighthouse.

What happens is that the sound—or the light—is reflected in the direction we wish. When a sound is made anywhere, the law is that the waves spread out equally in all directions at the same speed and with the same power. But sound can be reflected exactly like light, and if we desire it to be heard specially well at any point, we must arrange to reflect it toward that point. We cannot make the sound louder than it is, but we can get more of it to reach the place that we desire.

This applies equally well, whether the sound is coming or going. We may put a trumpet on the phonograph, or we may use a speaking-trumpet for our own voices, if we want to speak at sea or to a large company in the open air. Or, on the other hand, we may put the trumpet in our ears, as deaf people do, where it acts in just the same way, reflecting toward the canal of the ear a certain amount of sound which would not otherwise have reached it. Our own ears act as reflectors of this kind in a smaller degree.

The making of echoes by walls is really just the same as the action of a trumpet; only when the wall is far away the reflected sound comes so long after the first sound that we hear two sounds. Walls help a speaker if they are close beside or behind him, but not otherwise.

WHY CANNOT WE FLY IN THE AIR AS WE SWIM IN THE WATER?

The two problems of swimming and flying are exactly the same in principle. In both cases, the body is heavier than the thing around it, and the problem is, somehow or other, to prevent it from sinking. But, in the case of swimming, the thing around the body, or *medium,* as we call it, is much nearer the heaviness of the body itself than in the case of air, and so the task is much less difficult. It is still less difficult in sea-water than in fresh, because sea-water is heavier. It is possible, however, for an animal that is not a bird, and that is made on very much the same principles as ourselves, to fly; and that animal is the bat. The bat knows, so to speak, as the Wright Brothers know, that if we want to fly, we must expose a large surface to the air, so as to get all we can out of the supporting power of the air.

So the bat, with his fingers of the same pattern as our own, enormously long, and a web stretched between them, is thus provided with two beautiful aeroplanes, and can fly. We really see the same thing, as regards swimming, in the case of many web-footed birds, web-footed frogs and newts, and other similar creatures.

ARE NEW CLOUDS ALWAYS BEING MADE?

Clouds are always being made and unmade. No cloud lasts for more than a short time, and the surface of a cloud all round is constantly changing The making and unmaking of clouds depend, from moment to moment, upon a great many different conditions in the air; for instance, the temperature of the air, the amount of moisture it contains, the nature and temperature of winds, the amount of dust in the air, and the state of the electricity in the air at the time.

These things are changing from moment to moment; indeed, it is not possible that they can all remain the same for two moments together. The earth never ceases to spin, and this means that different parts of the air are being brought under the rays of the sun or out of them. Even though the sun is shining on parts of the air for many hours at a time, the spinning of the earth makes it shine at a different angle, which alters the force of its rays. As the sun shines it warms the air, and so increases the amount of water which it can hold in the form of transparent water-vapor rather than in the form of clouds.

So clouds are always being made and melted here and there, as no one needs telling who has been able to spare time to watch the face of the sky steadily and carefully for even a short period.

WHAT IS LIGHT MADE OF?

Light is a very real and powerful and precious thing—yet it is not a *thing,* as a chair is a thing; and it is quite correct to say that, in a sense, light is made of nothing. It is not a form of matter, it is not made of any elements or any compounds, there are no atoms in it; and it does not attract matter, nor is it attracted by matter. Light is a *state* of motion, or strain, or vibration, in the ether. If we may say that light is made of anything, then we must say that it is made of the ether—but the ether in a particular state of what we call wave-motion. If light were *material*—if it were made of matter—it would have to obey the law of gravitation, but we can prove that it does not.

Light is a kind of electricity. Here we mean electric waves, like those which pass along a wire in telegraphing or telephoning, or through the air in wireless telegraphy. In all these cases what really travels is a wave in the ether, and light is a wave of the same kind, traveling at the same rate exactly, and subject to the same laws in every way. Only the waves of light are shorter and the number of them that occur in a second is much larger than in the case of the ether. The difference is the same as that between a low note and a high note of sound.

Light, then, is a kind of electricity. The waves of light, of radiant heat, and of electricity, differ from the waves of sound: first, because they travel in the ether, and not in anything material; and, secondly, because they are waves from side to side, and not to and fro in the line of their flight through space.

WHY DOES A KETTLE NOT GET RED HOT WHEN IT IS HEATED?

If we have read the answer to the last question we shall be prepared to answer this one for ourselves; and the first thing that we shall notice is, that the question is not properly asked, for if we simply take a kettle and heat it, it *does* turn red hot. But what was meant, when this question was asked, was: How is it that the same kettle—which, of course, heated by itself would turn red hot—does not turn red hot when it is put on the fire, *after having been filled with water?*

Well, we know that the reason why a thing gives out light is, that it is hot. So it must be that, in some way, though we are applying heat to the kettle, it does not get hold of heat enough to make it luminous. The reason is, that water will hold more heat than any other thing we know, and that nothing is greedier of any heat in its neighborhood. So the water takes the heat from the kettle, and does not allow the bottom of the kettle ever to get hotter than the temperature of boiling water. That is hotter than our fingers like, but it is much below the temperature at which iron becomes luminous.

WHY DOES A PIECE OF IRON TURN RED WHEN IT IS HOT?

When iron turns red, this means, we know, that it is producing light of the particular kind that impresses our eyes as red, and we see the iron by this light. Of course, we see the iron when it is cold, but only by light reflected from its surface. If the cold iron be put in the dark, we cannot see it, but red-hot iron glows in the dark. The point is, then, that the red-hot iron shines by its own light—makes light of its own. Lumen is a Latin word for light, and so we say that the iron becomes luminous. The particular character of the light given out by the iron will depend upon how hot it is, for we know that if red-hot iron is heated it turns white. This fact about iron is common to most things, or, indeed, all things; when they are heated up to a certain point, they become luminous. Light, we know, is made of waves in the ether, and all we can say is, that the atoms of a hot thing move about so as to make those waves in the ether that we call light.

WHY CANNOT WE SEE THE SPOKES OF A WHEEL WHEN IT GOES VERY FAST?

The reason is that the marks made, so to speak, by anything upon the retina, or curtain, at the back of the eye do not instantly fade away, but last for a small fraction of a second. The real marvel here is that these images on the retina last for such a short time, and that it is so quickly ready to receive new ones. Still, the images do last for a little while, and if a wheel goes round at all quickly, the marks made by the spokes at the different parts of their journey run into each other, and we see no distinct spokes at all, but only a faint blur inside the circle of the wheel.

The first answer to this question that would naturally suggest itself to our minds is, that the spokes of the wheel cannot be seen when it turns quickly because they are moving too fast for the eye to catch. That, however, is not the case at all, and a simple experiment will show that the first explanation is the true one, and not this, likely though it sounds. If we set a wheel spinning in darkness, and then have a single flash of electric light just for an instant, we catch a glimpse of the spokes of the wheel all seeming fixed in one place, as if the wheel were not moving at all.

WHAT IS THE ETHER?

Ether is the chemical name of a sweet-smelling liquid, made of carbon, hydrogen, and oxygen, which, like chloroform, produces a peculiar kind of sleep for surgical operations. But when we speak of *the* ether we mean something utterly different. Of course, we should have two different words for the two things, but we have not. If we understood the ether, we should have the key to almost every puzzle we find in Nature. At present we know very little about it, but we are sure of certain facts. The ether is *everywhere*. We cannot believe that there is any gap or space or crack in it. It cannot be seen, yet we may say that we see nothing else, for light is a state of the ether, and light is the only thing we can see.

The ether has no weight, yet it is the cause of weight, in a sense, for weight is due to gravitation, and it is through the ether that gravitation acts. And we believe that matter is really made of the ether—that "the electric" particles, or electrons, of which the atoms of matter are composed, themselves consist of things in the ether which we can only dimly picture to ourselves as knots or lumps of ether.

Yet, though we do not know how, there is now really no doubt that the ether is the universal mother of all matter, and of all material things; it is the element of elements, and we cannot pierce behind it to anything, but to the Author of all that is.

ARE WE HEALTHIER THAN OUR ANCESTORS?

Certainly we are—far healthier. The death-rate has been falling all over the United States for many years. We know at what ages our ancestors commonly died—even those who had most wealth and knowledge. We know that, long ago, the children of the kings and queens died at much the same rate as the children of the slums do nowadays. We know hideous diseases which raged in America and are now unknown, or very rare. Only a generation ago, for instance, typhus fever was very common, and now it hardly causes ten deaths in the whole of America in a year, though the disease is still sadly common in some very poor countries.

Nothing is more foolish or stupid than to talk of the "good old days," as if every one had been happy, and wise, and strong, long ago. The more we learn of the "good old days," the more we learn how bad they were, and how much better off we are now; though our children's children will think we were bad enough, when they have abolished consumption and other terrible diseases which we could abolish at any time if only we were wise enough.

WHY DOES A BRIDGE SWAY IF MANY PEOPLE KEEP STEP UPON IT?

The swaying of the bridge is really the same as the swinging of a swing, or the to-and-fro movement of the pendulum of an old-fashioned clock. All these *vibrations*—a word which simply means tremblings—obey the same law. Other instances of the same kind of thing may be found in cases where a huge rock, perhaps, is balanced so that if we press against it at the right intervals it can be set rocking, though no living man could move it in an ordinary way.

The secret lies in the time when we apply our force. The bridge is set swaying because many little forces are applied at the same moment. The swing swings well because we give it a little push at just the right moment.

It is the same in games. People think that the man who hits hardest or farthest at tennis or baseball is the best hitter, but that is not quite the case. The best hitter is the best "timer," the man who times the ball, and applies his force at exactly the right moment. Twice the force applied a second sooner or later than it should be would not produce half the result.

WHEN WE RUN INTO A WALL, DOES THE WALL PUSH US BACK?

Sir Isaac Newton discovered three laws of motion, the second of which deals with this question. Newton's second law is that "action and reaction are equal and opposite," and wherever action happens, we find that this is true.

When a bullet is fired forward from a gun, for instance, the gun gives a kick back, which we call its recoil, and that is its reaction; and if we could compare the weight and the speed of the gun backward with the weight and the speed of the bullet forward, we should find that action and reaction were not only opposite, but also strictly equal.

When we run, with elbows bent, we notice how the elbow goes forward as the foot of the same side strikes the earth backward. That is another example of the same thing.

If we push a wall, the wall must push us, and the amount of pressure we exercise on the wall is exactly equal and opposite, in accordance with Newton's law, to the pressure which the wall exercises on us when we run into it.

WHAT MAKES US GROW?

We cannot fully explain growth, because growth depends upon life, and we cannot fully explain life; but there are certain laws of growth which we know. The first is that, to begin with, our food makes us grow; this is true of all growth everywhere, whether of a cabbage or a child. Growth is, among other things, the addition of new material to the body.

Now, though life is so marvelous, it obeys the laws of Nature, and we have proved that all living things obey the law that matter cannot be made out of nothing. Therefore, the new matter added to itself by the living body is derived from the food; and that is why the feeding of living creatures while they are still growing is so very important.

This all sounds as if we understood the whole of growth, but that is far from the truth. For in the case of every human being or animal there comes a time when no amount of food will cause growth. There are laws inside the living body which decide when it shall stop growing, and a man of thirty will never get any taller, however much he eats. Even a tree, though it may get thicker as long as it lives, will not grow taller after a time.

Mere adding of matter is not growth. A man who is ill, or who eats and drinks too much and does not do enough work, may get heavier and heavier—perhaps by storing up water, perhaps by storing up fat in his body. But that is not growth. *Real* growth is only the outward visible sign of development, as when an acorn develops into an oak; and the causes of development still lie hidden deep in the nature of life.

WHY DO PLANTS GIVE OUT OXYGEN ONLY IN THE DAYTIME?

The oxygen which plants give out is not derived from any source in themselves, nor does it come up in the sap from the roots. If that were so, it might be given off at night as well as in the daytime. But all the oxygen given out by plants comes from carbonic acid, which is an extremely firmly made compound of carbon and oxygen.

There is always a certain amount of carbonic acid in the air—about three and a half parts in ten thousand parts of air—and this is where the plants get the carbonic acid from. But the great power with which the carbon and oxygen are united, of course, requires a power at least equally great in order to separate, or to *dissociate,* them, to use the proper word. There is no power in the plant itself strong enough for this, but the tremendous power of sunlight is strong enough, and the plant really plays merely the part of taking the power of sunlight in such a way as to force apart the atoms of carbon and oxygen in carbonic acid. When daylight fails, therefore, this process must cease.

Though we say that all the plant does is merely to use the sunlight, yet we should also add that this is more than we can do. No matter how strong the light that we use may be, or what devices we employ, we cannot with any amount of trouble separate the elements in carbonic acid, as every green leaf can do without any trouble at all.

WHAT CAUSES TUBERCULOSIS?

Tuberculosis is caused by a microbe, which was discovered in Germany twenty-eight years ago. We catch it from each other, and from the milk — and occasionally the flesh — of cows, which suffer from it just as we do if they are kept in badly ventilated places. The disease is now diminishing in America, England, France, and Germany, and will go on diminishing the more we act on our knowledge of its cause. They do this best in Germany, and tuberculosis is decreasing much more rapidly there than it is here. We are just beginning here to protect ourselves from the milk of tubercular cows, to punish people for spitting in trains and street cars, and to learn to keep our bedroom windows open. When you who are children, and who read this now, have grown up to be men and women, tuberculosis will probably be as rare as typhus fever is to-day.

The children of to-day will be the grown-up people who govern America and vote for members of Congress in a few years to come; and the next generation will learn that the health of the people is the best possession of a nation, and will know how to obtain it. The children of to-day, and even more their children, will look back on us, who allowed ourselves to be killed by tuberculosis at the rate of about one in seven of all deaths — and they will not talk of the "good old days."

WHY DO FIELDS APPEAR TO MOVE WHEN WE ARE IN A TRAIN?

When we sit still in a train, we notice that, compared with the seats and walls of the carriage, our bodies are not moving, and so we half get the idea into our minds that we are really at rest. Then, as we look out of the windows, we keep in our heads, more or less, the notion that we are at rest, and therefore we argue that the results of the motion, which is certainly going on somewhere, are due to the fields, and so on.

This is one of countless instances where we are deceived, and all these instances teach the same lesson—that our ideas of motion are made of comparison between one thing and another; but which thing is moving, or moving most, is another matter. The proper way of saying this is that all our notions of motion are relative, not absolute.

A train gives us another instance, for we all know that we may be deceived when there is a train on the line next ours. Often we cannot tell which of the two trains is really moving. But by far the most famous and important mistake of this kind that has ever been made is the case of the earth and sun and the stars. In our train, which is the earth, we move every day and night, and the fields of the sky, with their white flowers, the stars and the mighty sun, seem to move across our path and pass us.

We make the mistake the eye makes when we look out of a train; and it cost hundreds of years and vast trouble and many lives to prove that it is *our train* or the earth, that is moving.

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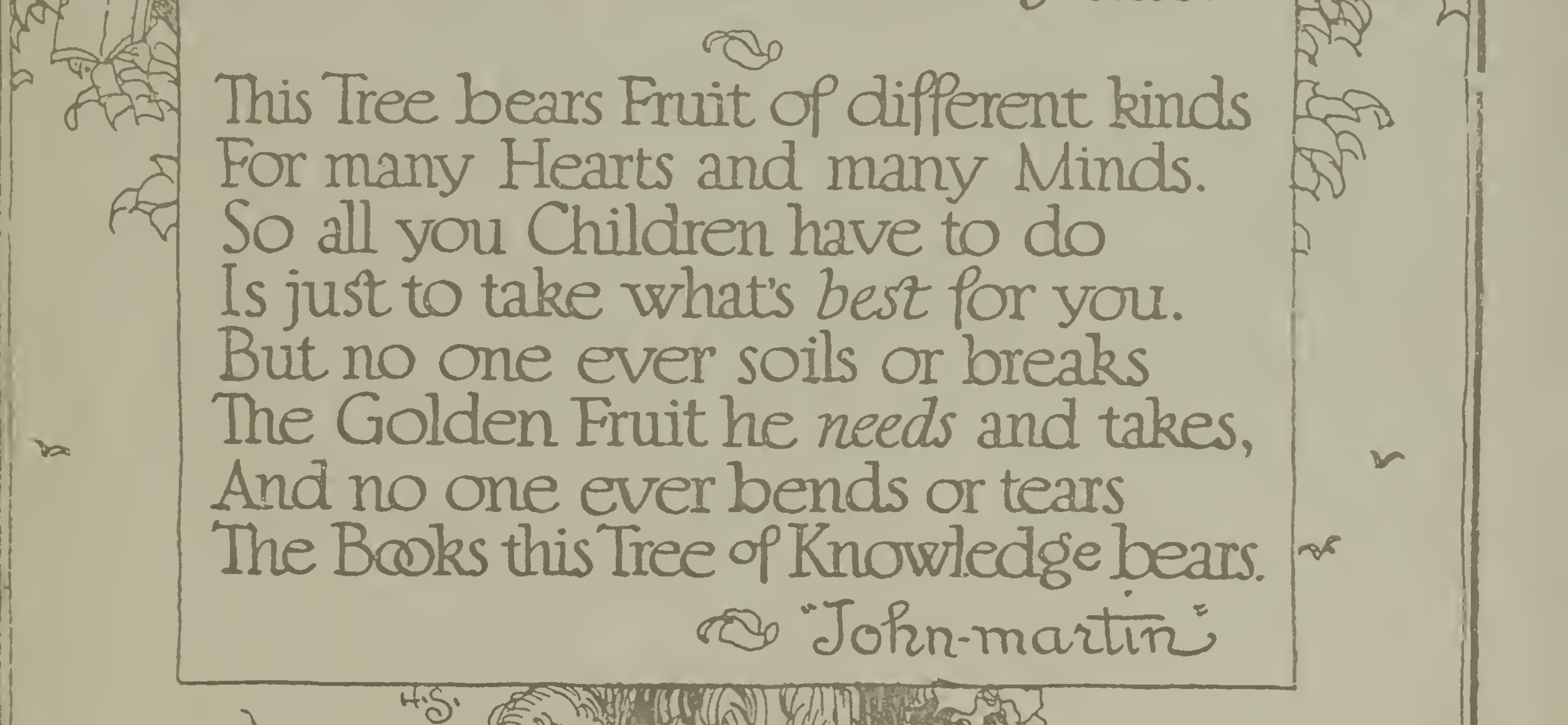
The Books this Tree of Knowledge bears.

"John-martin"



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